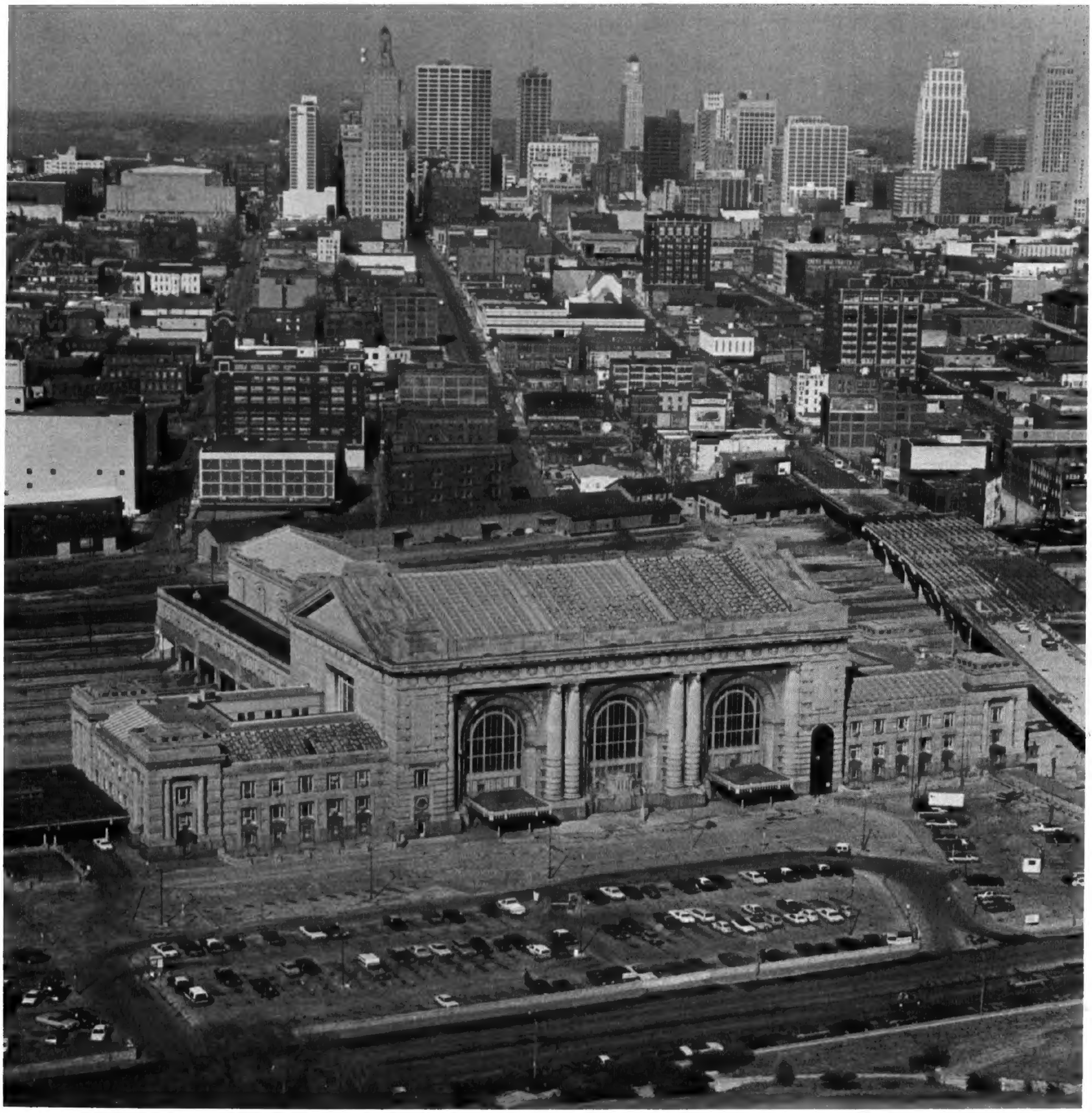
United States
Department of
Agriculture

Soil
Conservation
Service

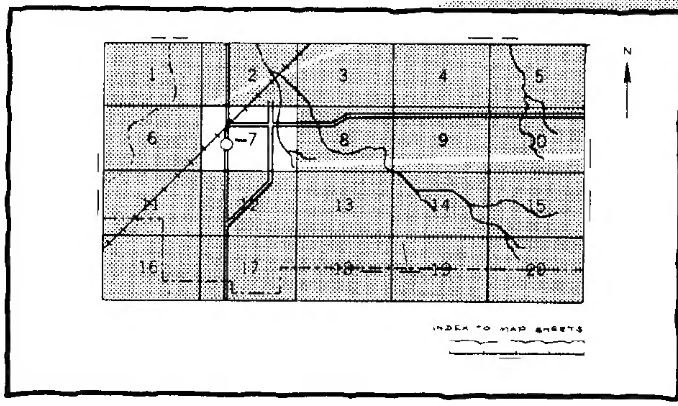
In cooperation with
the Missouri
Agricultural
Experiment
Station

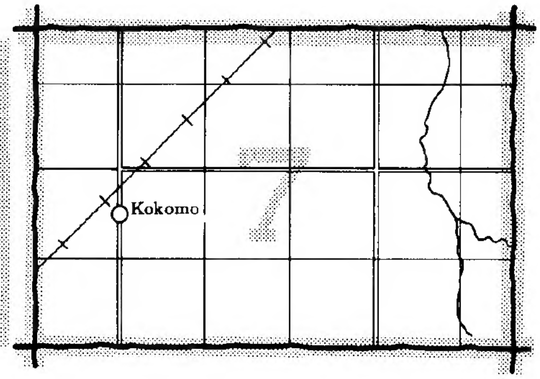
Soil Survey of Jackson County, Missouri



HOW TO USE

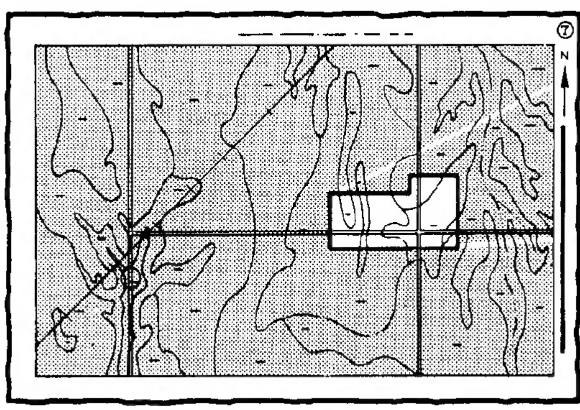
1. Locate your area of interest on the "Index to Map Sheets"

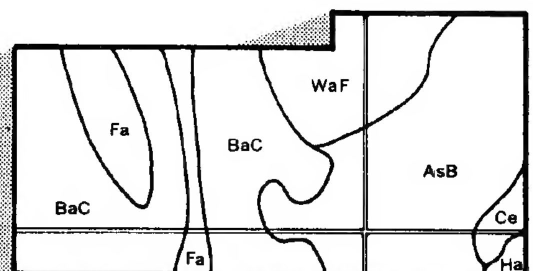




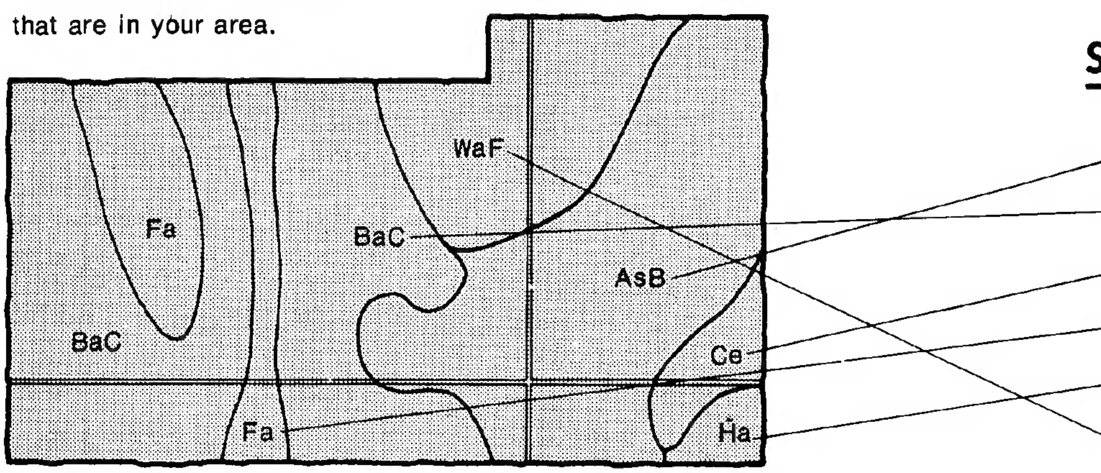
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area.



Symbols

AsB
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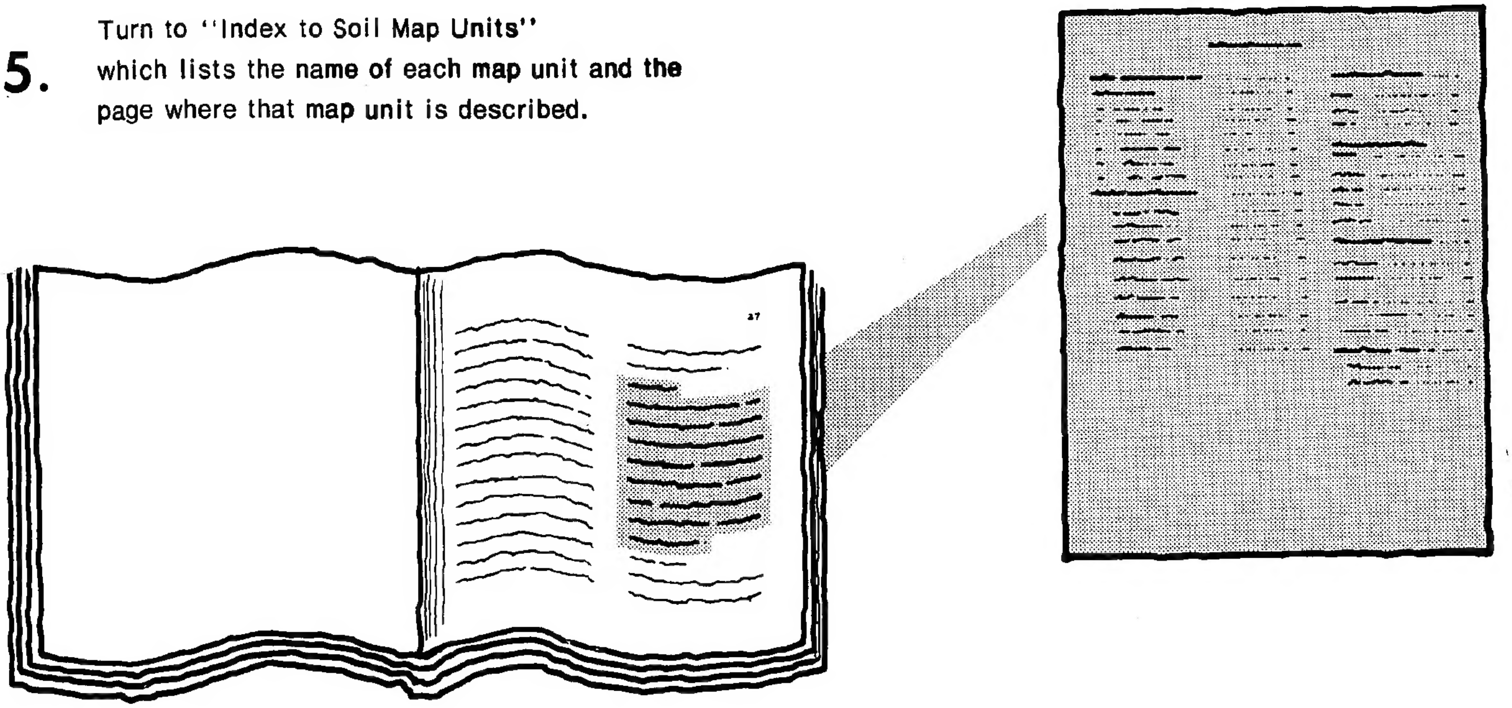
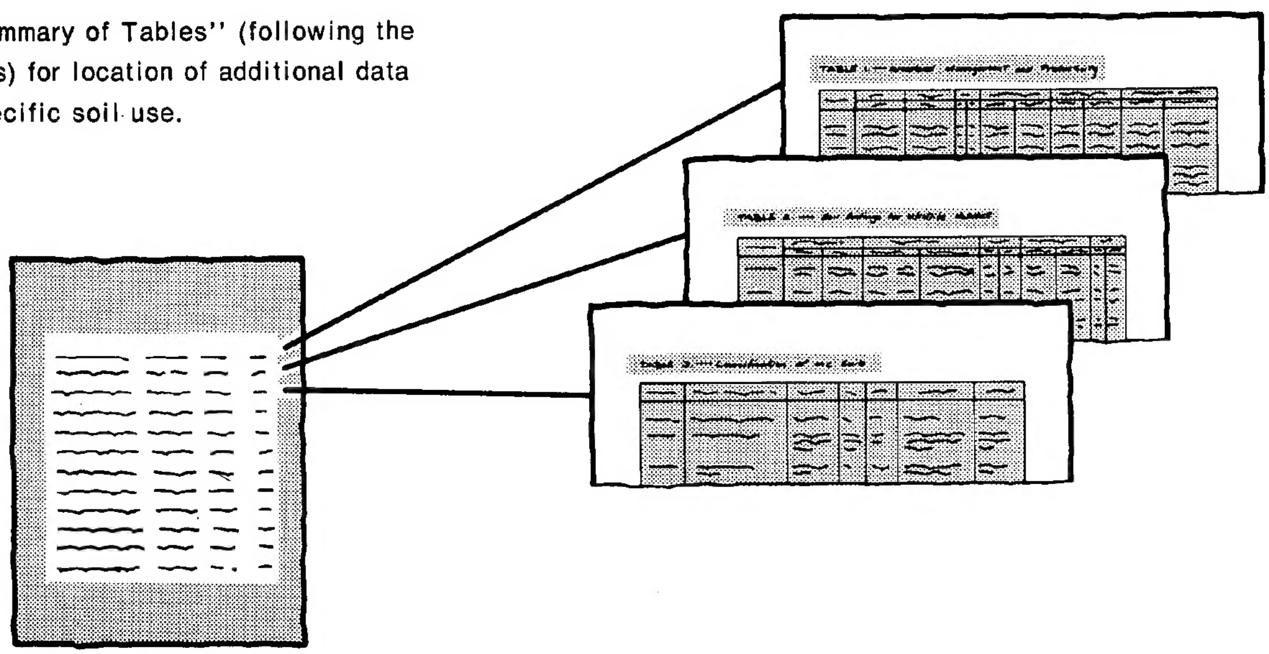
THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1975-81. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. Jackson County, through the Department of Planning and Zoning, provided a soil scientist to assist with the fieldwork. The city of Kansas City, through the Department of Engineering, provided a soil scientist to map that part of the survey area within the corporate limits of the city. This survey is part of the technical assistance furnished to the Jackson County Soil and Water Conservation District.

Cover: The Union Station in Kansas City, Missouri. This famous landmark, constructed in 1914, is now used only as an Amtrak stop and a large restaurant.

Contents

Soil Series

Issued September 1984

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Jackson County, Missouri. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Paul F Larsen

Paul F. Larsen
State Conservationist
Soil Conservation Service

Soil Survey of
Jackson County, Missouri

By George D. Preston, Soil Conservation Service

Fieldwork by George D. Preston and Leslie W. Tobin, Soil Conservation Service, Roxanne Crow and Richard D. Douglas, Jackson County Soil and Water Conservation District, and Chris Noble, city of Kansas City

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Missouri Agricultural Experiment Station

JACKSON COUNTY is in the west-central part of Missouri (fig. 1). In 1980 Independence, the county seat, had a population of 111,806, and Kansas City, the largest city, had a population of 371,991. Jackson County had a total population of 629,180. The county has a total area of about 394,419 acres or about 616.3 square miles, which includes about 3,456 acres of water areas more than 40 acres in size.

Jackson County is in the Iowa and Missouri Deep Loess Hills Resource Area of the Central Feed Grains and Livestock Region of the United States (*3*). The Missouri River is the northern boundary of the county. The northern part of the county is the nearly level flood plain of the Missouri River. Adjacent to the flood plain and south are moderately sloping to steep, loess-covered bluffs and hills. The rest of the county consists of gently sloping to moderately sloping uplands and flood plains of the Blue River, Little Blue River, Sni-A-Bar Creek, and their tributaries. The flood plains of these streams are relatively narrow, and the adjacent, moderately sloping to steep uplands have numerous Rock outcrops of limestone.

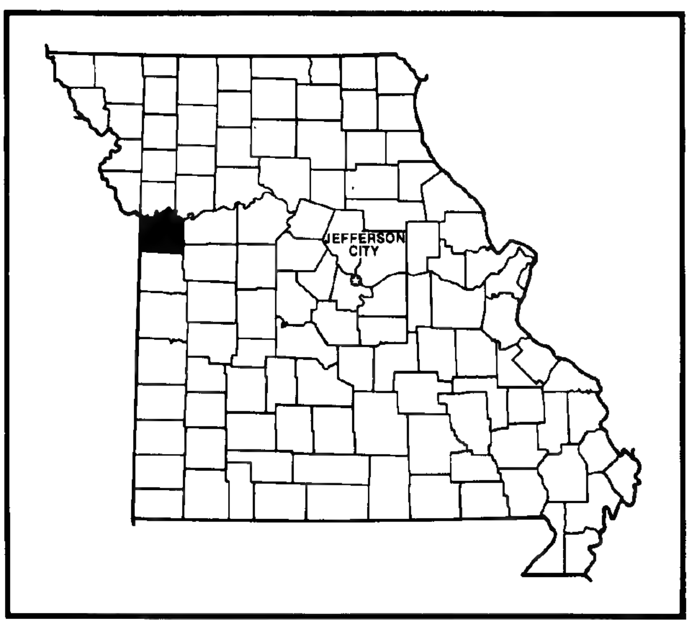


Figure 1.—Location of Jackson County in Missouri.

Commerce and industry are important enterprises in Jackson County. The importance of farming has diminished, but farm products and other agribusiness are still highly important to the city of Kansas City and the surrounding areas. The processing of grain, grain products, and other farm products provide employment for many people in this area.

An earlier soil survey was made for Jackson County, Missouri, and published by the United States Department of Agriculture in 1912 (*13*). The present survey updates the 1912 survey, provides a more detailed soil survey with aerial photography, and contains more interpretative information.

General Nature of the Survey Area

This section gives general information concerning the county. It discusses climate; history and development; water supply; and physiography, relief, and drainage.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

The consistent pattern of climate in Jackson County, Missouri, is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer when moist air from the Gulf of Mexico interacts with drier continental air. The annual rainfall is normally adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Kansas City, Missouri, in the period 1951 to 1979. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 33 degrees F, and the average daily minimum temperature is 24 degrees. The lowest temperature on record, which occurred at Kansas City on February 1, 1979, is -10 degrees. In summer the average temperature is 78 degrees, and the average daily maximum temperature is 88 degrees. The highest recorded temperature, which occurred on July 13, 1954, is 112 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 35.75 inches. Of this, 25 inches, or 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 7.45 inches at Kansas City on August 15, 1969. Thunderstorms occur on about 55 days each year, and most occur in summer.

The average seasonal snowfall is 22 inches. The greatest snow depth at any one time during the period of record was 21 inches. On the average, 10 days have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally but are local and of short duration. Damage varies and is spotty. Hailstorms occur at times during the warmer part of the year in an irregular pattern and in small areas.

History and Development

Beverly E. Brejcha assisted in the preparation of this section.

The Hopewell Indians and, later, the Osage Indians were early inhabitants of the Jackson County area. They were farmers and hunters and traded with settlements in other areas.

Jackson County was part of the Louisiana Territory and became part of the Louisiana Purchase in 1803. In 1808 the United States government built Fort Osage on the loess bluffs overlooking the Missouri River (fig. 2) and encouraged settlement in the area. The first settlers were from other states, particularly from Virginia, Kentucky, and Tennessee. The first settlement was at Sibley, near Fort Osage.

Jackson County was established in 1826 and included Cass and Bates Counties. It was named for President Andrew Jackson. The present boundaries were established on March 3, 1835 (*5*).

During the 1830's Independence, Westport, and Kansas City became starting places for pioneers emigrating to the West Coast along the Santa Fe, California, and Oregon Trails. Farmers in the Jackson County area sold much of their produce to these travelers. Farming activities were nearly halted during the years of the Civil War when the county was occupied by Federal troops. They resumed slowly when the war was over.

In 1868 Texas ranchers began to drive their cattle to Kansas City for marketing, and the railroads built stockyards to receive and transfer the stock. Kansas City became the main source of supply for packed beef. Thirteen railroad lines crossed Jackson County by 1880, and Kansas City was a center for connecting East and West. The first barge line between Kansas City and St. Louis was established in 1880 (*5*).

Crop failure, resulting from a locust invasion in 1874-75, made the farmers of Kansas and Jackson County dependent upon Iowa and parts of Missouri for wheat and other grain for spring planting. Kansas City handled these imports and by the fall of 1875 had become an important grain market for the region.

A good water supply and an abundance of native grasses produced excellent grazing conditions. Large numbers of horses, cattle, hogs, and sheep were raised. Corn and wheat were also cultivated and marketed. In 1880 the county produced 4,000,000 bushels of corn and 1,000,000 bushels of wheat. Other crops, such as oats, barley, rye, tobacco, field and garden vegetables, and apples, peaches, grapes, pears, and berries were also grown in large amounts. Many of these crops are still cultivated. Jackson County, and especially the Kansas City area, grew rapidly from the late 1800's through the early 1900's.

Present day Jackson County has 6 airports, 12 railroad lines, 5 river barge lines, and many truck lines. Soil

Figure 2.—Restoration of Fort Osage on the Knox Bluffs above the Missouri River.

erosion and urban development, resulting in losses of large areas of prime farmland, are serious concerns. Recognizing a need to meet these problems, a group of farmers organized the Soil and Water Conservation District in 1974. In 1979 the entire county was included in the District.

Water Supply

Most of the soils on uplands in Jackson County are suitable for the construction of ponds and small reservoirs. These impoundments provide most of the livestock with water. They could supply some households with water if they were properly located and treated and in places could supply a small amount of water for irrigation.

Water from the consolidated rock formations that underlie Jackson County generally is of poor quality and is below the standards set by the United States Public Health Service for drinking water. Water from deep wells is high in chlorides and sulfates. Yields generally are low from shallow wells. The output is about 5 gallons per minute and many wells go dry during periods of low rainfall (*7*).

Wells in the alluvium along the smaller streams produce small amounts of water. At one time the city of Buckner got its water supply from the alluvium of Fire Prairie Creek; however, this source proved unsatisfactory, and the city now obtains water from Missouri River alluvium.

The principal source of present and future ground water supplies for Jackson County is the Missouri River alluvium. This source is widely used in Independence and other cities in Jackson County. Water for Kansas City comes directly from the Missouri River. The source of water for rural water districts is the Missouri River alluvium (*8*).

In addition, several center-pivot irrigation systems have been installed in the last few years that use the Missouri River alluvium as a source of water.

The water table in the Missouri River alluvium generally is between 5 and 25 feet below the surface of the flood plain. The alluvium reaches a maximum of 100 feet in thickness and averages between 80 and 90 feet (*8*).

Wells that have modern construction will yield more than 2,000 gallons per minute in favorable locations. Based on data from the Kansas City area, however, yields are between 500 and 1,500 gallons per minute and average about 1,000 gallons per minute (*8*).

Physiography, Relief, and Drainage

The Missouri River flood plain is one of the major physiographic areas in Jackson County. It is in the northern part of the county and ranges from less than 1/4 mile to more than 3 miles wide. Most of the flood plain is level or nearly level, except on some of the old natural levees, where the slope may be more than 5 percent. The silty and sandy soils generally are close to the river, and the more clayey soils generally are closer

Figure 3.—A thick exposure of Bethany Falls limestone.

to the uplands. Some of the old channels are low and wet and can be farmed only during periods of low rainfall.

The bedrock of Jackson County is cyclic deposits of limestone and shale. The tilt of the bedrock generally is from southeast to northwest. The Bethany Falls limestone is the most conspicuous rock formation in the county (fig. 3). It is the most extensively quarried limestone in northwestern Missouri (*10*). Many abandoned underground quarries are now being developed for storage and office space.

A mantle of loess covers most of the bedrock on the uplands. The loess is thickest close to the Missouri River and gradually becomes thinner to the south as the distance away from the river increases. The loess is also thinner on the side slopes adjacent to the secondary streams and in areas where there are numerous limestone Rock outcrops. The area adjacent to the Missouri River flood plain is deeply dissected with narrow ridgetops and steep side slopes. Farther south on the divides between the secondary streams, the topography becomes gently sloping to moderately sloping. These areas have wide ridges. Close to the secondary streams, the topography becomes more broken. These areas have narrow, loess-covered ridges and are dissected with drainageways. Below the loess-covered areas, the slopes are steeper, and most of the loess has been eroded away.

There is little evidence of glacial action in Jackson County. During the Kansan glaciation, the glacier pushed south of the Missouri River a short distance, but most of the glacial debris is covered with loess. However, some glacial material occurs in a few places in the deeply dissected valleys adjacent to the Missouri River flood plain.

There are two abandoned valleys in Jackson County. The Buckner Valley in the northeastern part of the county stretches from the Little Blue River through the city of Buckner toward the Missouri River. It has an area similar to that of the valley of the Little Blue River to the south. Buckner Valley was apparently occupied by that stream at some stage of its history. It is now drained by Fire Prairie Creek directly into the Missouri River. The other valley is a small, abandoned, partially filled valley that stretches across the northern part of Kansas City from Turkey Creek, which is just across the state line in Kansas, to the Blue River Valley in the northeastern part of the city. This valley appears to have once been occupied by Turkey Creek (*9*).

Most of Jackson County drains north directly into the Missouri River or its tributaries within the county. It drains in a northerly direction. A small area, less than 10 percent of the county, drains in a southerly direction into the Osage River drainage system and then into the Missouri River. Major tributaries of the Missouri River are the Blue River, the Little Blue River, Fire Prairie Creek, and Sni-A-Bar Creek.

Elevation in Jackson County ranges from 1,105 feet on the divide in the south-central part of the county to 690 feet at normal water level on the Missouri River at the county line on the eastern side of the county.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another resulting in gradual changes in characteristics. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they

drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and do not affect use and management. These soils are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use and require different management. These soils are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation to precisely define and locate the soil is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other associations but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Descriptions, names, and delineations of soils in this survey do not fully agree with soil maps of adjacent counties published at a different date. Differences are the result of additonal soil data, intensity of mapping, and correlation decisions that reflect local variations. In some places it is more feasible to combine small acreages of similar soils that respond to use and management in much the same way than it is to separate these soils and give them different names.

Descriptions of the associations in Jackson County follow.

1. Haynie-Urban land-Leta association

Urban land and deep, nearly level, moderately well drained and somewhat poorly drained soils that formed in alluvium; on the Missouri River flood plain

This association consists of the broad Missouri River flood plain (fig. 4).

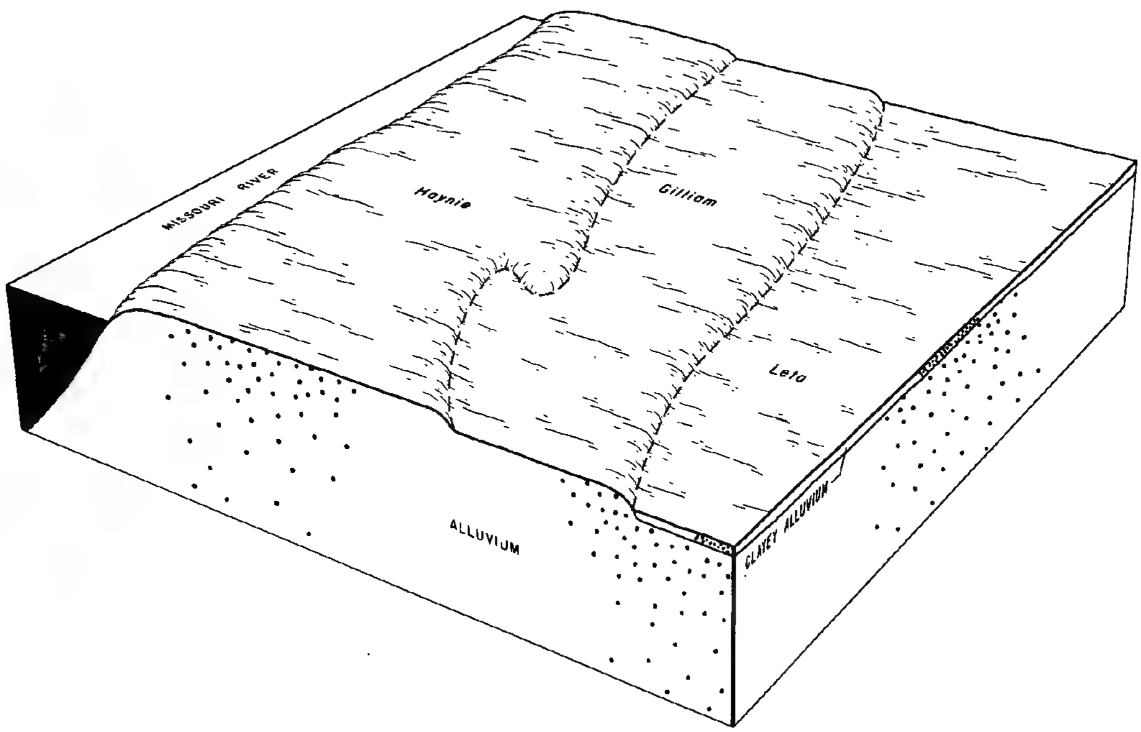


Figure 4.—Relationship of soils and parent material in the Haynie-Urban land-Leta association.

This association makes up about 7 percent of the county. It is about 36 percent Haynie soils, 23 percent Urban land, 17 percent Leta and similar soils, and 24 percent soils of minor extent.

The moderately well drained Haynie soils are on slightly raised positions close to the river or close to old abandoned channels. The surface layer is very dark grayish brown silt loam. The substratum is stratified, dark grayish brown and brown, friable very fine sandy loam in the upper part and dark grayish brown, very friable silt loam in the lower part.

Urban land consists of areas that are covered by structures and pavements. It makes up that part of the Kansas City urban land area that is in the Missouri River flood plains.

The somewhat poorly drained Leta soils are in broad, slightly depressional areas of the bottom lands. The surface layer is very dark gray, firm silty clay. The subsurface layer is very dark gray, very firm silty clay. The subsoil is dark grayish brown, very firm silty clay. The substratum is dark grayish brown, mottled, very friable very fine sandy loam.

Of minor extent in this association are the Bremer, Gilliam, and Modale soils. Bremer soils have less sand in the subsoil and substratum than Haynie and Leta soils and are poorly drained. They formed in silty alluvium and are close to the uplands. Gilliam soils are silty throughout and are grayer than Haynie soils. They formed in stratified, loamy alluvium and are in areas between Haynie and Leta soils. Modale soils formed in silty alluvium over clayey alluvium. They are at a slightly higher elevation than Leta soils.

The soils in this association are used for cultivated crops and for urban roads and structures. Corn, soybeans, and wheat are the principal crops. Wetness and the high clay content are the main concerns in management of these soils.

The soils in this association are protected by levees but may flood if a levee breaks. Previous flooding history should be considered in the design of any building site development and placement of sanitary facilities.

2. Knox-Sibley-Urban land association

Urban land and deep, gently sloping to steep, well drained soils that formed in loess; on uplands

This association consists of soils on narrow to moderately wide ridgetops and side slopes interspersed with areas of Urban land. Slopes generally are short (fig. 5).

This association makes up about 27 percent of the county. It is about 29 percent Knox soils, 26 percent Sibley and similar soils, 17 percent Urban land, and 28 percent soils of minor extent.

The moderately sloping to steep, well drained Knox soils are on the deeply dissected uplands adjacent to the Missouri River flood plains. The surface layer is very dark grayish brown silt loam, and the subsurface layer is brown silt loam. The subsoil is dark yellowish brown, firm and friable silty clay loam, and the substratum is dark yellowish brown, friable silt loam.

The gently sloping and moderately sloping, well drained Sibley soils are on moderately wide ridgetops and convex side slopes. The surface layer is very dark brown silt loam. The subsurface layers are very dark brown silt loam and very dark grayish brown silty clay loam. The subsoil is dark brown and brown, firm silty clay loam in the upper part and dark yellowish brown, mottled, firm silty clay loam in the lower part. The substratum is mottled grayish brown and yellowish brown, friable silt loam.

Urban land consists of areas that are covered by structures and pavements. It includes the downtown section of Kansas City and the adjacent areas that are mapped in complex with Harvester, Knox, and Sibley soils.

Of minor extent in this association are the Harvester, Higginsville, and Snead soils. Harvester soils are moderately well drained. They formed in reworked material that has been graded and reshaped for urban and suburban development. These soils are in yards, gardens, and small areas around buildings. Higginsville soils are somewhat poorly drained. They are at the heads of drainageways. Snead soils are moderately deep and moderately well drained. They are in lower positions on side slopes.

The gently sloping and moderately sloping areas of the Knox and Sibley soils are used for cultivated crops. The strongly sloping and moderately steep areas are used for pasture and hay. Most of the steep areas are in woodland. The gently sloping to strongly sloping areas are used for urban roads and structures. The hazard of erosion and steepness of slope are the main concerns if these soils are used for cultivated crops, pasture, and hay.

The soils in this association are suited to building site development and onsite waste disposal. Slope, shrink-swell potential, and frost action are the main limitations.

3. Higginsville-Sibley-Sharpsburg association

Deep, gently sloping and moderately sloping, somewhat poorly drained to well drained soils that formed in loess; on uplands

This association consists of ridgetops and upland side slopes on broad divides between the major drainageways (fig. 6).

This association makes up about 10 percent of the county. It is about 33 percent Higginsville and similar soils, 25 percent Sibley soils, 22 percent Sharpsburg soils, and 20 percent soils of minor extent.

The moderately sloping, somewhat poorly drained Higginsville soils are at the heads of drainageways and on slightly concave side slopes. The surface layer is very dark brown, friable silt loam. The subsurface layer also is

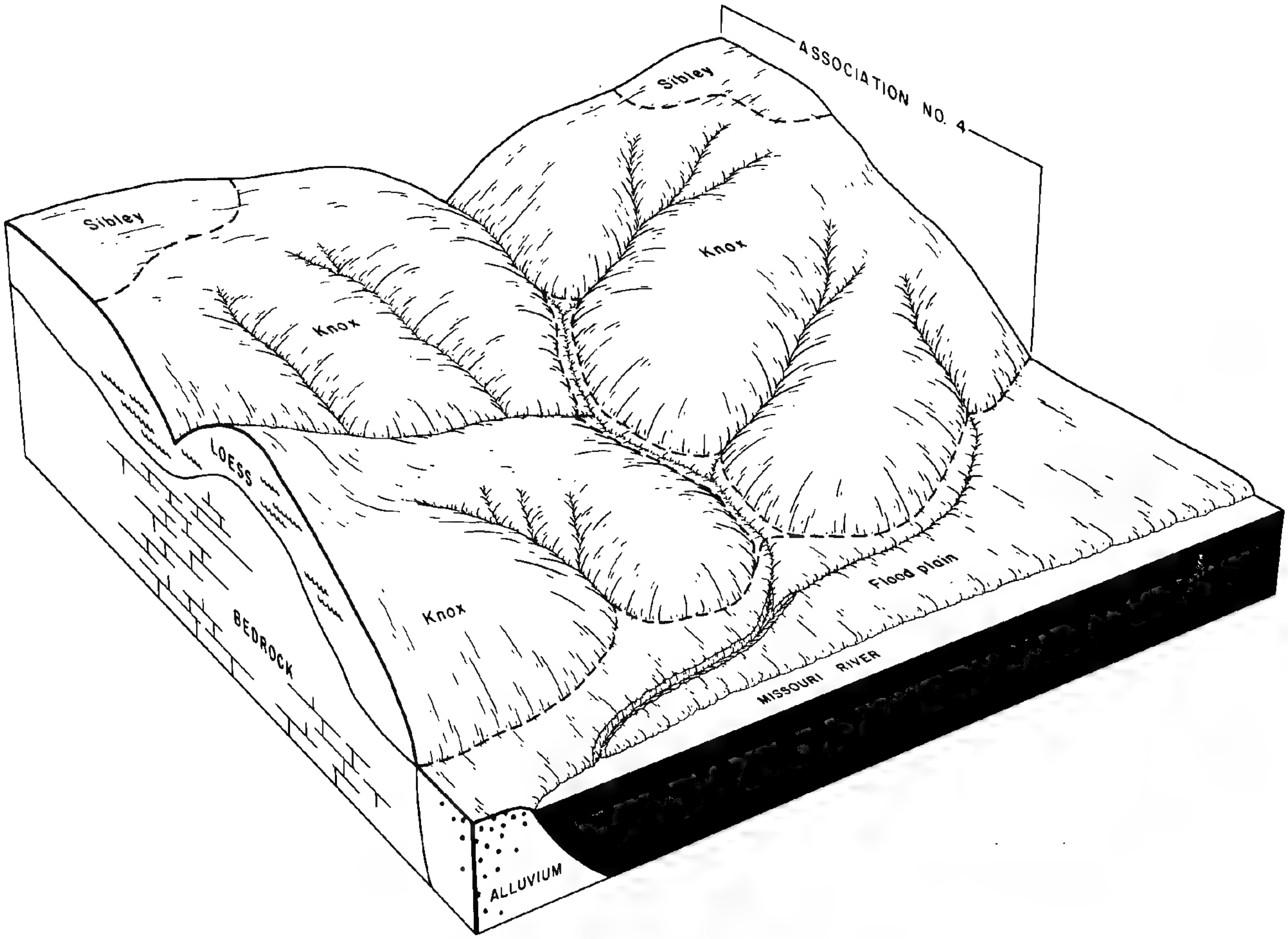


Figure 5.—Relationship of soils and parent material in the Knox-Sibley-Urban land association.

very dark brown, friable silt loam. The subsoil is very dark grayish brown, friable silty clay loam in the upper part; dark brown and brown, mottled, firm silty clay loam in the middle part; and grayish brown, mottled, friable silty clay loam in the lower part. The substratum is grayish brown, mottled, friable silty clay loam.

The gently sloping and moderately sloping, well drained Sibley soils are on moderately wide, convex ridgetops and convex side slopes. The surface layer is very dark brown silt loam. The subsurface layers are very dark brown silt loam and very dark grayish brown silty clay loam. The subsoil is dark brown and brown, firm silty clay loam in the upper part and dark yellowish brown, mottled, firm silty clay loam in the lower part. The substratum is mottled grayish brown and yellowish brown, friable silt loam.

The gently sloping and moderately sloping, moderately well drained Sharpsburg soils are on convex ridgetops and convex side slopes. The surface layer is very dark grayish brown silt loam. The subsurface layers are very dark grayish brown silt loam and silty clay loam. The subsoil is dark brown, firm silty clay loam in the upper part and dark brown and dark yellowish brown, mottled, firm silty clay loam in the lower part. The substratum is dark yellowish brown, mottled, firm silty clay loam.

Of minor extent in this association are the Kennebec and Snead soils. Kennebec soils are nearly level. They have less clay than the major soils in this association and are on the flood plains of small streams. Snead soils are moderately deep and are on convex, lower side slopes.

The soils in this association are used mainly for cultivated crops. The principal crops are corn, soybeans, grain sorghums, and wheat. The hazard of erosion and the drainage of seepy areas are the main concerns in the management of these soils.

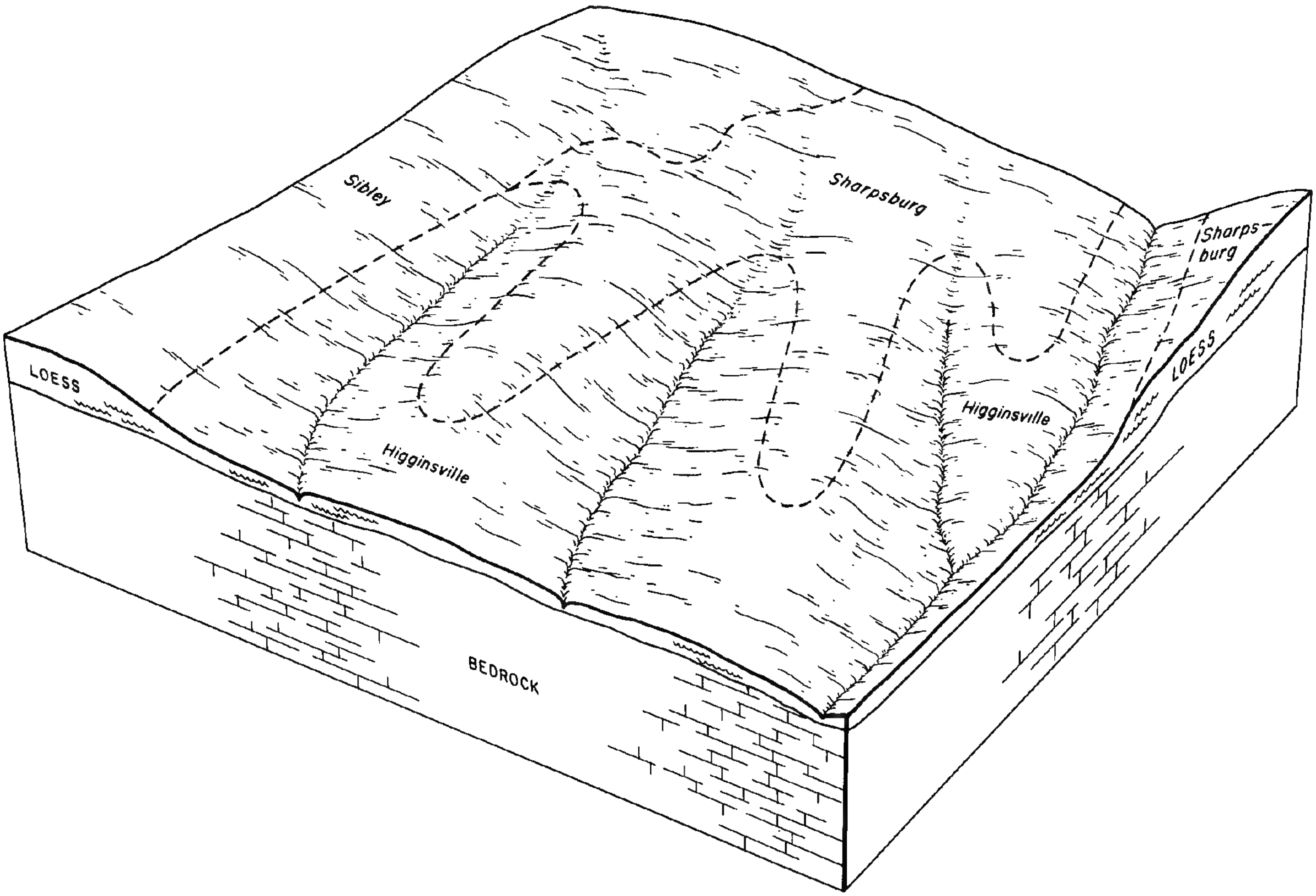


Figure 6.—Relationship of soils and parent material in the Higginsville-Sibley-Sharpsburg association.

The soils in this association generally are suited to building site development and onsite waste disposal. Wetness, shrink-swell potential, low strength, and slope are limitations.

4. Snead-Menfro-Oska association

Moderately deep and deep, gently sloping to steep, well drained and moderately well drained soils that formed in loess or residuum from shale and limestone; on uplands

This association consists of strongly dissected uplands that are adjacent to the flood plains of intermediate and small streams. These areas have numerous Rock outcrops (fig. 7).

This association makes up about 20 percent of the county. It is about 32 percent Snead soils, 25 percent Menfro soils, 11 percent Oska soils, and 32 percent soils of minor extent.

The moderately deep, moderately sloping to steep, moderately well drained Snead soils are on the lower slopes of convex side slopes. They are in a complex with Rock outcrops. The surface layer is black, firm flaggy silty clay loam, and the subsurface layer is very dark grayish brown, firm flaggy silty clay loam. The subsoil is dark grayish brown, firm silty clay in the upper part and olive, mottled, firm silty clay in the lower part. The substratum is yellowish brown and black, soft weathered shale.

The gently sloping to strongly sloping, well drained Menfro soils are on narrow, convex ridgetops and convex side slopes at a higher elevation than Snead soils. The surface layer is brown silt loam. The subsoil is dark yellowish brown and dark brown, firm silty clay loam. The substratum is dark yellowish brown, friable silt loam.

The moderately deep, moderately sloping, well drained Oska soils are on convex side slopes at a higher elevation than the Snead soils. The surface layer is dark brown silty clay loam. The subsoil is dark reddish brown, friable silty clay loam in the upper part; reddish brown, firm silty clay loam and brown, firm gravelly silty clay in the middle part; and yellowish brown, firm silty clay loam

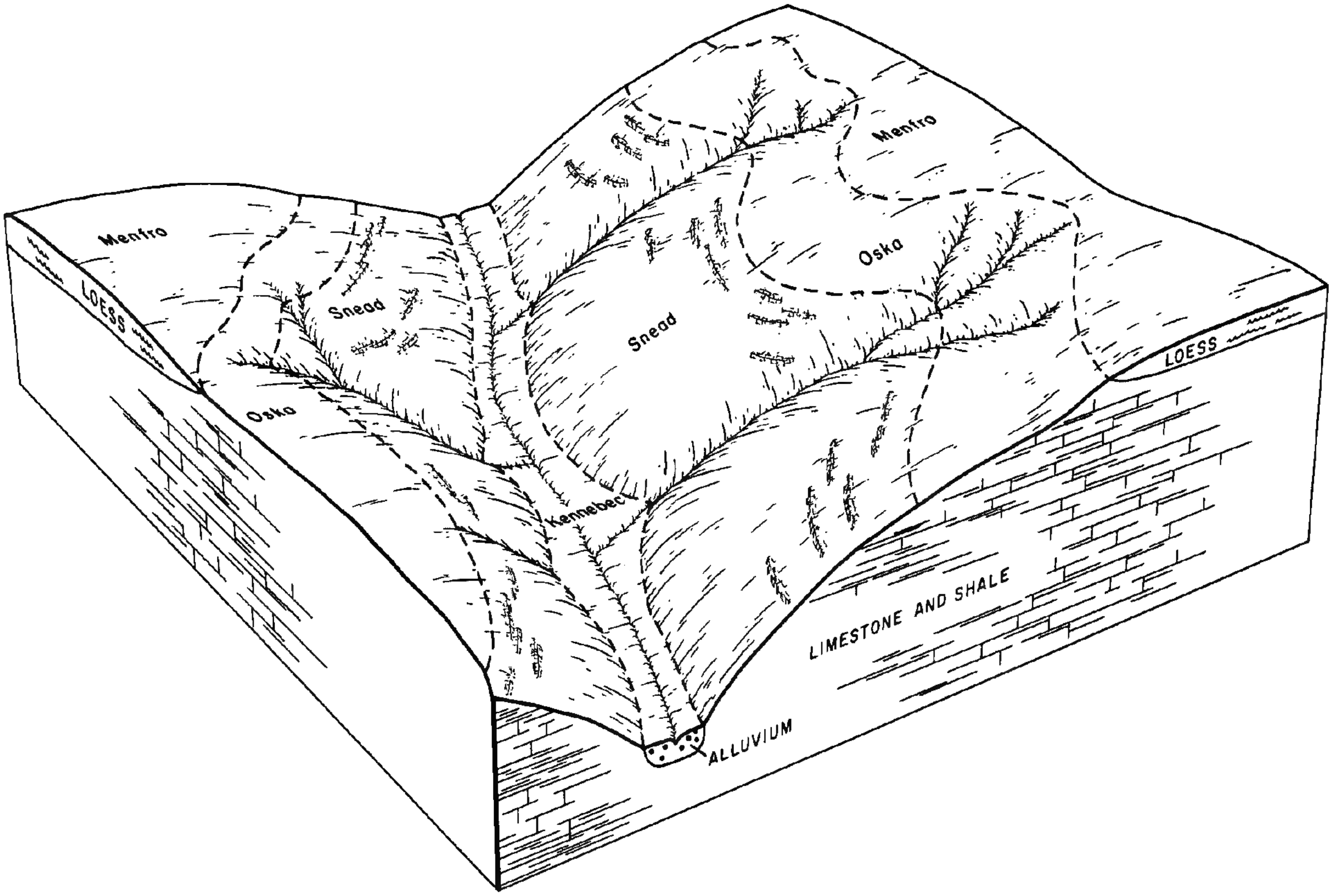


Figure 7.—Relationship of soils and parent material in the Snead-Menfro-Oska association.

in the lower part. The subsoil is underlain by hard limestone bedrock.

Of minor extent in this association are the Kennebec, McGirk, Polo, and Weller soils. Kennebec soils are nearly level and are silty throughout the profile. They are on the narrow flood plains of the smaller streams. McGirk soils are moderately sloping and somewhat poorly drained. They are on convex foot slopes. Polo soils are gently sloping and moderately sloping and are of redder hue than the major soils in this association. They are on convex ridgetops and convex side slopes at a higher elevation than the Snead soils. Weller soils are gently sloping. They have grayer mottles in the upper part of the subsoil than the major soils and are on moderately wide, convex ridgetops at a higher elevation than Oska and Snead soils.

About 60 percent of the gently sloping to strongly sloping soils in this association is used for pasture and hay. The rest is used for cultivated crops or is in woodland. Cool-season bunch grasses are the main pasture and hay plants. Corn, soybeans, grain sorghums, and wheat are the principal cultivated crops. Slope and the hazard of erosion are the main concerns in pasture and cropland management.

Most of the moderately steep and steep soils in this association are in woodland. The steep slopes limit the use of logging equipment. Erosion is a hazard along logging roads and skid trails.

The Oska and Snead soils generally are unsuitable for onsite waste disposal. Slope, depth to bedrock, and shrink-swell potential are the main limitations for building site development. The Menfro soils are suitable for building site development and onsite waste disposal, but slope, shrink-swell potential, and frost action are limitations.

5. Macksburg-Sharpsburg-Sampsel association

Deep, gently sloping and moderately sloping, moderately well drained to poorly drained soils that formed in loess or residuum from shale and limestone; on uplands

This association consists of moderately wide to wide ridgetops and slightly concave side slopes. It is on the higher divides between the larger streams (fig. 8).

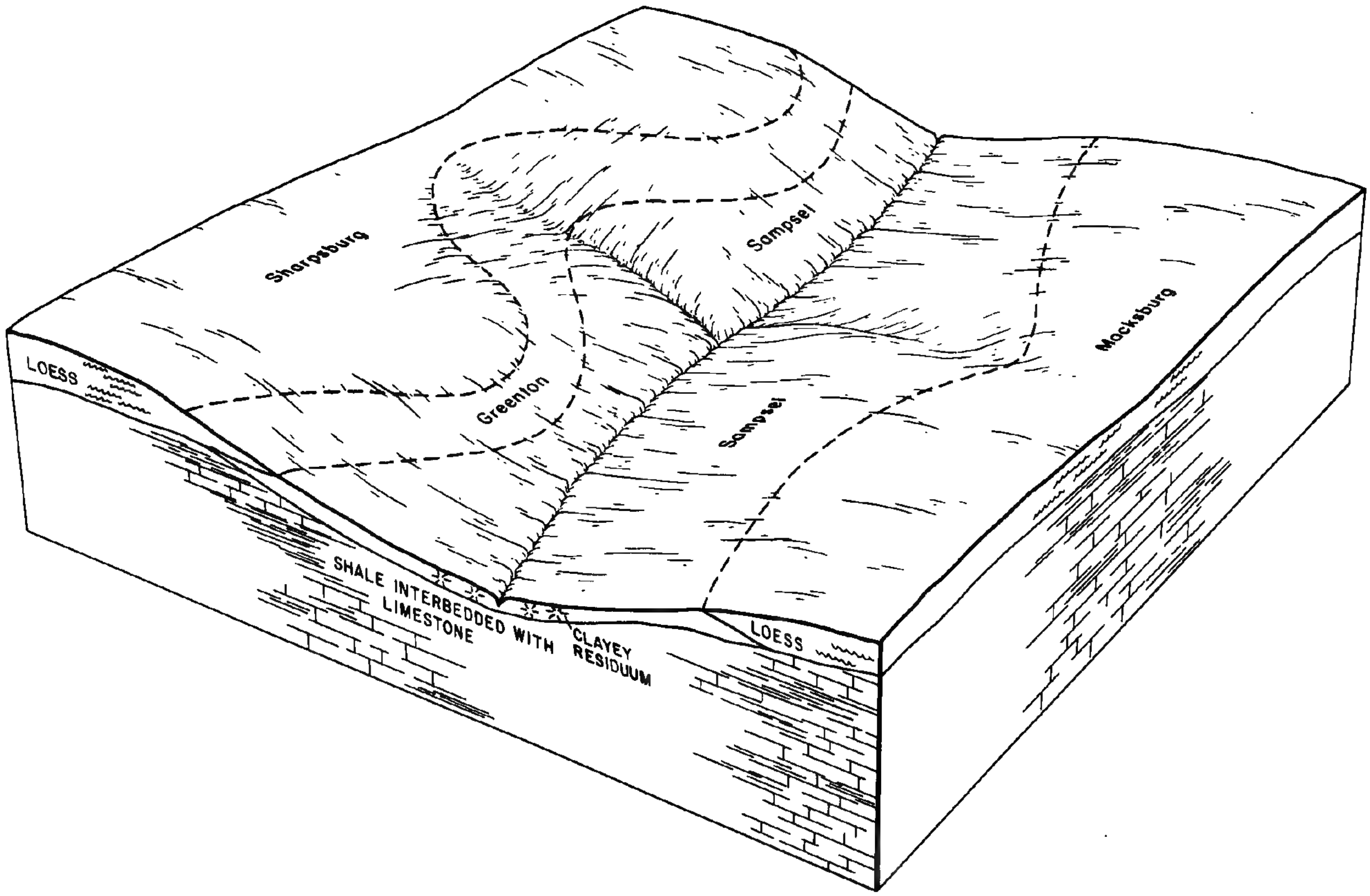


Figure 8.—Relationship of soils and parent material in the Macksburg-Sharpsburg-Sampsel association.

This association makes up about 26 percent of the county. It is about 28 percent Macksburg and similar soils, 23 percent Sharpsburg and similar soils, 18 percent Sampsel soils, and 31 percent soils of minor extent.

The somewhat poorly drained Macksburg soils are on wide, convex ridgetops. The surface layer is black silt loam. The subsurface layer is black silty clay loam. The subsoil is dark grayish brown, mottled, firm silty clay loam in the upper layer and grayish brown, mottled, firm silty clay loam below. The substratum is grayish brown, friable silty clay loam.

The moderately well drained Sharpsburg soils are on moderately wide, convex ridgetops. The surface layer is very dark grayish brown silt loam. The subsurface layers are very dark grayish brown silt loam and silty clay loam. The subsoil is dark brown, firm silty clay loam in the upper part and dark brown and dark yellowish brown, mottled, firm silty clay loam in the lower part. The substratum is dark yellowish brown, mottled, firm silty clay loam.

The poorly drained Sampsel soils are on broad, convex ridgetops and slightly concave side slopes. They are at a lower elevation than the Sharpsburg and Macksburg soils. The surface layer is black silty clay loam. The subsoil is very dark gray, firm silty clay in the upper part; dark grayish brown, mottled, very firm silty clay in the middle part; and gray, mottled, very firm silty clay in the lower part.

Of minor extent in this association are the Greenton, Menfro, and Sibley soils. Greenton soils are similar to Macksburg soils. The well drained Menfro soils are on ridgetops and ends of ridges close to the streams. The well drained Sibley soils are on moderately wide ridgetops at a higher elevation than Sharpsburg soils.

The soils in this association are used mainly for cultivated crops. Corn, soybeans, grain sorghums, and wheat are the principal crops. The hazard of erosion and wetness are the main concerns for cultivated crops.

The soils in this association are suited to building site development and onsite waste disposal. High shrink-swell potential, wetness, slow permeability, frost action, and slope are the main limitations.

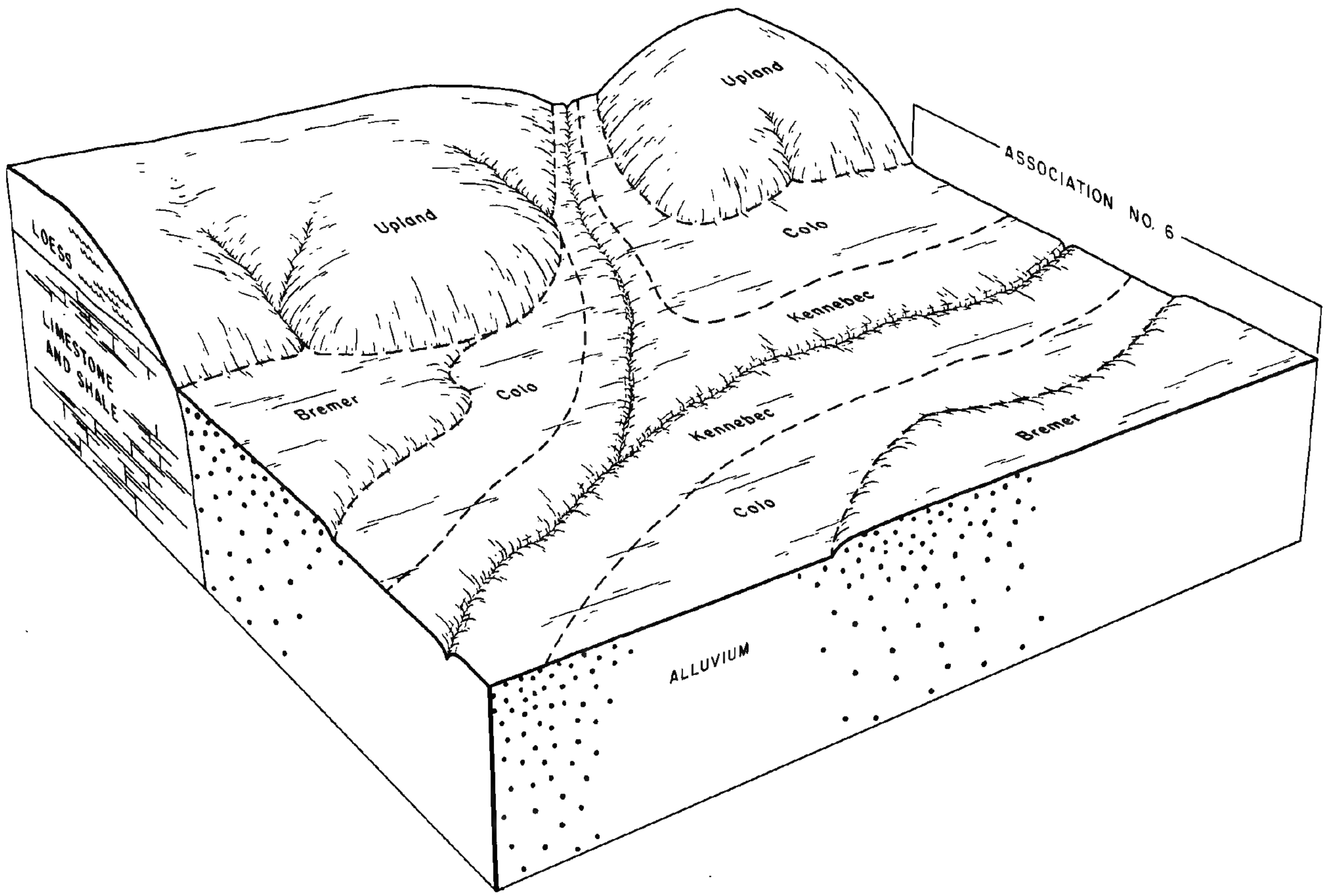


Figure 9.—Relationship of soils and parent material in the Kennebec-Colo-Bremer association.

6. Kennebec-Colo-Bremer association

Deep, nearly level, moderately well drained and poorly drained soils that formed in alluvium; on flood plains and terraces

This association is on the flood plains and terraces of the Missouri River tributaries (fig. 9).

This association makes up about 10 percent of the county. It is about 37 percent Kennebec soils, 24 percent Colo and similar soils, 21 percent Bremer soils, and 18 percent soils of minor extent.

The moderately well drained Kennebec soils are on natural levees close to the stream channels. The surface layer is very dark grayish brown silt loam. The subsurface layers are very dark grayish brown silty clay loam in the upper part and black silty clay loam in the lower part. Below this is a transitional layer of very dark grayish brown silty clay loam. The substratum is very dark grayish brown silt loam.

The poorly drained Colo soils are on flood plains between the Kennebec soils and the uplands. The surface layer is very dark gray, friable silty clay loam. The subsurface layers are black, firm silty clay loam. The subsoil is black, firm silty clay loam in the upper part and very dark gray, firm silty clay loam in the lower part. The substratum is very dark gray, firm silty clay loam.

The poorly drained Bremer soils are on low stream terraces. The surface layer is black silt loam. The subsoil is very dark gray and dark gray, mottled, firm silty clay loam in the upper part; dark grayish brown, firm silty clay loam in the middle part; and multicolored, firm silty clay loam in the lower part.

Of minor extent in this association are the Napier, Wabash, and Zook soils. The well drained Napier soils on very gently sloping toe slopes at the mouths of upland drainageways. The very poorly drained Wabash soils are on the broader flood plains of secondary streams. The poorly drained Zook soils are on flood plains of secondary streams between the Colo soils and the uplands.

The soils in this association are used mainly for cultivated crops. Wetness, the hazard of flooding, and

the high clay content are the main concerns in farming these soils.

The soils in this association generally are unsuited to building site development and onsite waste disposal because of flooding.

Broad Land Use Considerations

Deciding which land should be used for urban development is an important issue in the survey area. Each year a considerable amount of land is developed for urban uses in Kansas City, Independence, Lees Summit, and other cities in the county. In addition, land in the rural areas is being subdivided for housing developments and even small acreages are commonly being used for housing. About 73,000 acres, or about one-fifth of Jackson County, is now in urban or built-up land. The general soil map is most helpful for planning the general outline of urban areas. It cannot be used for selection of sites for specific urban structures. In general, soils that are well suited to cultivated crops in the survey area are also well suited to urban development. The data about specific soils in this survey can be helpful in planning future land use patterns.

Areas where the soils are so unfavorable that urban development is prohibited are not extensive in the survey area. However, the Haynie-Urban land-Leta association and the Kennebec-Colo-Bremer association are on flood plains. On these associations flooding and wetness are severe limitations.

Parts of the Snead-Menfro-Oska association are steep, and in some places bedrock is a few feet below the surface. Urban development is costly in these areas. Urban development is also costly on the steep, unstable soils in the Knox-Sibley-Urban land association. In addition, many parts of the Macksburg-Sharpsburg-Sampsel association are not well suited to urban development because of wetness and high shrink-swell potential.

Large areas of the county, however, are made up of soils that can be developed for urban uses at lower costs than the soils named above. The less sloping parts of the Knox-Sibley-Urban land association, the better drained parts of the Higginsville-Sibley-Sharpsburg association, and the deeper, less sloping parts of the Snead-Menfro-Oska association are examples. Because these soils are also excellent farmland, agricultural use should not be overlooked when broad land uses are being considered.

The coarser textured, better drained soils of the Haynie-Urban land-Leta association are well suited to specialty crops, such as melons, potatoes, sweet corn, and other vegetables. The Knox-Sibley-Urban land association is well suited to orchards, vineyards, and nurseries. The selection of a site for specialty crops is dependent upon the requirements of the particular crops. For this reason, site location should be considered individually.

The less sloping areas of the Knox-Sibley-Urban land association are well suited to parks and extensive recreational uses. Most of the soils in the survey area can provide suitable opportunities for recreation. Data about specific soils in this survey can be helpful in planning future recreational uses. All of the associations provide habitat for many species of wildlife.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Knox silt loam, 5 to 9 percent slopes, is one of several phases in the Knox series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils or one or more soils and a miscellaneous area. These soils occur in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Sibley-Urban land complex, 2 to 5 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Descriptions of the detailed soil map units in Jackson County follow.

1B—Sibley silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on moderately wide, convex ridgetops. Individual areas are long and moderately wide and range from 10 to 150 acres.

Typically, the surface layer is very dark brown, friable silt loam about 7 inches thick. The subsurface layers are very dark brown, friable silt loam and very dark grayish brown, friable silty clay loam about 18 inches thick. The subsoil is firm silty clay loam about 42 inches thick. The upper part is dark brown; the middle part is brown; and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 76 inches is mottled grayish brown and yellowish brown, friable silt loam. In places the very dark brown and dark brown soil in the upper part of the profile is less than 24 inches thick, and grayish brown mottles are at a depth of less than 36 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Higginsville and Macksburg soils. Higginsville soils are on side slopes at a lower elevation than Sibley soils, and Macksburg soils are on broad ridgetops and saddles. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in this Sibley soil, and surface runoff from cultivated areas is medium. Reaction ranges from medium acid to neutral in the surface layer. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. The surface layer is friable and easily tilled through a moderately wide range of moisture content. It does,

however, have a tendency to crust or puddle after hard rains, especially if plowed when wet. The shrink-swell potential is moderate.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghums, small grains, and grasses and legumes for pasture and hay. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, good crop residue management, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture and hay is also an effective means of controlling erosion. The soil is suited to alfalfa, smooth bromegrass, and other grasses and legumes. Alfalfa needs a high level of fertility. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices should be used. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to building site development and onsite waste disposal. Septic tanks function adequately if installed properly. The soil should be graded for sewage lagoons and slowly permeable material used to seal the bottom of the lagoon. The shrink-swell potential is a limitation for dwellings and small commerical buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength.

This Sibley soil is in capability subclass IIe.

1C—Sibley silt loam, 5 to 9 percent slopes. This deep, moderately sloping, well drained soil is on convex side slopes of drainageways and narrow, convex ridges. Individual areas are irregular in shape and range from 5 to 40 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layers are very dark brown, friable silt loam and very dark grayish brown, friable silty clay loam about 13 inches thick. The subsoil is about 39 inches thick. The upper part is very dark brown, friable silty clay loam, and the lower part is dark yellowish brown, friable silty clay loam. The substratum to a depth of about 70 inches is dark yellowish brown, friable silt loam. In places the dark soil in the upper part of the profile is less than 24 inches thick and grayish brown mottles are at a depth of less than 36 inches.

Included with this soil in mapping are small areas of Higginsville and Knox soils. The somewhat poorly drained Higginsville soils are at the heads of drainageways and on the lower part of side slopes. Knox soils have a thinner, dark surface layer than the Sibley soils and are on the steeper side slopes. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in this Sibley soil, and surface runoff from cultivated areas is medium. Reaction ranges from medium acid to neutral in the surface layer. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. The surface layer is friable and easily tilled through a moderately wide range of moisture content. It does, however, have a tendency to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material. The shrink-swell potential is moderate.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. Sibley soils are well suited to alfalfa (fig. 10), smooth bromegrass, and other grasses and legumes. Alfalfa needs a high level of fertility. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices should be used. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to building site development and onsite waste disposal if proper design and installation procedures are used. Sewage lagoons should be placed on the less sloping areas, and the floor of the lagoon should be sealed with slowly permeable material to prevent seepage. Septic tanks will function adequately if they are properly installed. The shrink-swell potential is a limitation for dwellings and small commercial buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced and a backfill of sand and gravel placed around the foundation or basement wall to help prevent structural damage caused by the shrinking and swelling of the soil. Leveling or land shaping is needed for small commercial buildings because of slope. Low strength and frost action are

Figure 10.—Alfalfa hay on Sibley silt loam, 5 to 9 percent slopes.

limitations for local roads and streets. Grading the roads to shed water and providing adequate side ditches and culverts help to prevent damage caused by frost action. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Sibley soil is in capability subclass IIIe.

2C—Higginsville silt loam, 5 to 9 percent slopes. This deep, moderately sloping, somewhat poorly drained soil is on upland side slopes. Individual areas are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is very dark brown, friable silt loam about 7 inches thick. The subsurface layer is also very dark brown, friable silt loam about 5 inches thick. The subsoil is about 37 inches thick. The upper part is very dark grayish brown, friable silty clay loam; the middle part is dark brown and brown, mottled, firm silty clay loam; and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, friable silty clay loam. In places most of the original surface layer has been removed by erosion and the surface layer is dark grayish brown silty clay loam. In other places the subsoil is higher in clay content.

Included with this soil in mapping are small areas of well drained Sibley soils. Sibley soils are upslope from the Higginsville soils. The included soils make up less than 5 percent of the map unit.

Permeability is moderate in this Higginsville soil, and surface runoff from cultivated areas is medium. Reaction ranges from medium acid to neutral in the surface layer and from slightly acid to strongly acid in the subsoil. The available water capacity is high. A seasonal high water table is at a depth of 1.5 to 3 feet. Natural fertility is high, and organic matter content is moderate. The surface layer is friable and easily tilled through a fairly wide range in moisture content. It does, however, have a tendency to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material. The shrink-swell potential is moderate in the subsoil.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, soybeans, grain sorghums, and small grains. Some areas are wet and seepy, but properly placed drainage tile will correct this problem. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue or the

regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. The soil is best suited to shallow-rooted legumes and cool-season bunch grasses or to native warm-season grasses. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suitable for building site development. Septic tank absorption fields generally are unsuitable because of wetness. Sewage lagoons function adequately if the area can be leveled and the lagoon sealed to prevent contamination of the ground water. As an alternative, the waste can be piped to a more suitable area. Concrete for footings, foundations, and basement walls of dwellings and small commercial buildings should be reinforced with steel and a backfill of sand and gravel placed around the foundation or basement wall to prevent damage caused by shrinking and swelling of the soil. Drainage tile installed at the base of the sand and gravel helps to prevent damage caused by excessive wetness around the foundation and basement walls and wet basements. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action, shrinking and swelling of the soil, and wetness. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Higginsville soil is in capability subclass IIIe.

5B—Macksburg silt loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on moderately wide to wide ridgetops. Individual areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is black, friable silt loam about 10 inches thick. The subsurface layer is black, friable silty clay loam about 6 inches thick. The subsoil is about 38 inches thick. The upper part is dark grayish brown, mottled, firm silty clay loam, and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of 60 inches is grayish brown, mottled, firm silty clay loam. In places the substratum is silty clay.

Included with this soil in mapping are small areas of Sharpsburg and Sibley soils. The moderately well drained Sharpsburg soils are on narrower ridgetops than the Macksburg soils. The well drained Sibley soils are adjacent to the Macksburg soils but on slightly higher positions. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderately slow in this Macksburg soil, and surface runoff is slow. Reaction ranges from neutral to strongly acid in the surface layer. Natural fertility and

Figure 11.—Cattle grazing on bromegrass on Macksburg silt loam, 2 to 5 percent slopes.

available water capacity are high, and organic matter content is moderate. A seasonal high water table is at a depth of 2 to 4 feet. The surface layer is friable but has a narrow moisture range for tillage operations. It has a tendency to clod when tilled at a high moisture content. The shrink-swell potential is high in the subsoil.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage and winter cover crops helps to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. The soil is best suited to shallow-rooted legumes and cool-season bunch grasses or to native warm-season grasses (fig. 11). Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to building site development and onsite waste disposal (fig. 12). Septic tanks generally are not suitable in this soil. Sewage lagoons should be sealed with slowly permeable material to prevent contamination of the ground water. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand

and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. Drainage tile installed at the base of the sand and gravel helps to prevent wet basements. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Macksburg soil is in capability subclass IIe.

6B—Sharpsburg silt loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops. Individual areas are long and narrow and range from 5 to 90 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layers are very dark grayish brown, friable silt loam and silty clay loam about 15 inches thick. The subsoil is about 26 inches thick. The upper part is dark brown, firm silty clay loam, and the lower part is dark brown and dark yellowish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm silty clay loam. In places the dark soil in the upper part of the profile is more than 24 inches thick and grayish brown mottles are at a depth of more than 36 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Macksburg soils and well drained Menfro soils. Macksburg soils are on broader ridgetops than Sharpsburg soils. Menfro soils are at the ends of ridges closer to the drainageways. The included soils make up about 5 percent of the map unit.

Permeability is moderately slow in this Sharpsburg soil, and surface runoff is medium. Reaction ranges from slightly acid to strongly acid in the surface layer. Natural fertility and available water capacity are high. The organic matter content is moderate. The surface layer is friable and easily tilled through a fairly wide range in moisture content. It does, however, have a tendency to crust or puddle after hard rains. The shrink-swell potential is moderate.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grasses and legumes for pasture and hay. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. This soil is suited to alfalfa and smooth bromegrass. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

Figure 12.—Urban encroachment on Macksburg silt loam, 2 to 5 percent slopes.

This soil is suited to building site development and onsite waste disposal. Septic tank filter fields need to be larger than those commonly constructed because of moderate permeability in the lower part of the subsoil. Sewage lagoons should be sealed with slowly permeable material to prevent seepage. Concrete for footings, foundations, and basement walls of dwellings and small commercial buildings should be reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent damage caused by shrinking and swelling of the soil. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Sharpsburg soil is in capability subclass IIe.

6C2—Sharpsburg silt loam, 5 to 9 percent slopes, eroded. This moderately sloping, moderately well drained soil is on convex side slopes and narrow, convex ridgetops. Areas are irregular in shape and range from 5 to 60 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil is

about 41 inches thick. The upper part is very dark grayish brown, firm silty clay loam; the middle part is brown, firm silty clay loam that is mottled in the lower part; and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, friable silty clay loam. In places the upper part of the subsoil has been mixed with the surface soil and the surface layer is brown silty clay loam. In other places the dark soil layers in the upper part of the profile are more than 24 inches thick and the grayish brown mottles are at a depth of more than 36 inches.

Included with this soil in mapping are small areas of somewhat poorly drained Higginsville soils and well drained Menfro soils. Higginsville soils are on side slopes below the Sharpsburg soils. Menfro soils are at the ends of ridges and are closer to streams. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderately slow in this Sharpsburg soil, and surface runoff from cultivated areas is medium. Reaction ranges from slightly acid to strongly acid in the surface layer. Natural fertility is medium, and available water capacity is high. The organic matter content is moderate. The surface layer is friable and easily tilled through a fairly wide range in moisture content. It does, however, have a tendency to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material. The shrink-swell potential is moderate.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, further erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. This soil is suited to alfalfa and smooth bromegrass. Alfalfa needs a high level of fertility. Cuttings should be made by the early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices are needed. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to building site development and onsite waste disposal. Septic tank filter fields should be designed to operate on the slope, and the size of the filter field should be increased. Areas for sewage lagoons should be leveled by grading and the bottoms of the lagoons sealed with slowly permeable material to prevent seepage. Concrete for foundations and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Sharpsburg soil is in capability subclass IIIe.

8—Pits, quarries. This map unit consists of areas on uplands that are used or were used at one time to quarry for limestone. The areas generally are made up of quarry pits, stockpiles of limestone and crushed rock, and piles of spoil overburden, together with areas for storage of equipment and roads for transport. Areas range from 5 to about 130 acres.

The amount of soil material capable of supporting vegetation is small and variable; however, small hardwoods, annual weeds, and perennial grasses commonly grow in these areas.

The quarry pits in active use are dry, but most of the abandoned pits contain water. A detailed onsite investigation is needed before a change is made in the use of these areas.

Pits, quarries, is not assigned to a capability subclass.

10D—Snead-Rock outcrop complex, 5 to 14 percent slopes. This complex consists of moderately sloping to strongly sloping, moderately deep, moderately well drained Snead soils and narrow bands of limestone Rock outcrop on convex side slopes. Individual areas are long and moderately wide and range from 15 to 200 acres. This complex is about 60 to 70 percent flaggy Snead soil and 15 to 25 percent Rock outcrop. Rock outcrop occurs in such narrow bands that it is not practical to separate it from the Snead soils in mapping.

Typically, the Snead soil has a surface layer of black, firm flaggy silty clay loam about 10 inches thick. The subsurface layer is very dark grayish brown, firm flaggy silty clay loam about 4 inches thick. The subsoil is about 16 inches thick. The upper part is dark grayish brown, firm silty clay, and the lower part is olive, mottled, firm silty clay. Yellowish brown, weathered shale bedrock is at a depth of about 30 inches.

Included with this complex in mapping are small areas of deep Kennebec soils and well drained Oska soils. Kennebec soils are in narrow drainageways, and Oska soils are at a higher elevation than the Rock outcrop. The included soils make up about 10 percent of the map unit.

Permeability is slow in this Snead soil, and surface runoff is rapid. Reaction is slightly acid or neutral in the surface layer and ranges from neutral to moderately alkaline in the subsoil. Natural fertility is low, and organic

matter content is moderate. The available water capacity is low. The seasonal high water table is at a depth of 2 to 3 feet. The shrink-swell potential is high in the subsoil. Root development generally is restricted by shale bedrock below a depth of 20 to 40 inches.

Most areas of this complex are in trees or brush. The complex is not suited to cultivated crops, pasture, or hay. Because of the rocks and stones, cultivation is not practical, and the establishment of grasses and legumes would be very difficult.

This Snead soil is suited to trees, and most areas remain in native hardwoods. Restricted use of equipment, seedling mortality, windthrow, and plant competition are management concerns. Roads and skid trails should be placed on the contour. Planting special stock of larger size than usual or using container-grown stock may be necessary to achieve better survival rates. Lighter, less intensive but more frequent thinnings to reduce the stand density may be needed to lessen the damage from windthrow. Plant competition for seedlings can be reduced by careful and thorough site preparation, including spraying or cutting. Release treatments may be necessary to ensure development.

This Snead soil generally is unsuited to building site development and onsite waste disposal because of the high shrink-swell potential, stones in the soil, and depth to bedrock.

This Snead-Rock outcrop complex is in capability subclass VIs.

10F—Snead-Rock outcrop complex, 14 to 30 percent slopes. This complex consists of moderately deep, moderately steep to steep, moderately well drained Snead soils on convex side slopes and narrow bands of limestone Rock outcrop. Individual areas range from 15 to 255 acres. This complex is about 60 to 70 percent Snead soil and 15 to 25 percent Rock outcrop. The Rock outcrop occurs in such narrow bands that it is not practical to separate it from the Snead soils in mapping.

Typically, the Snead soil has a surface layer of black, friable flaggy silty clay loam about 7 inches thick. The subsurface layer is very dark gray, firm flaggy silty clay loam about 5 inches thick. The subsoil is about 19 inches thick. The upper part is dark grayish brown, firm silty clay, and the lower part is olive gray, mottled, firm clay. The substratum to a depth of about 40 inches is olive, firm silty clay.

Included with this complex in mapping are small areas of Kennebec and Oska soils. The deep Kennebec soils are in small bottoms along the drainageways, and the well drained Oska soils are along the upper edge of the complex. The included soils make up about 5 to 10 percent of the map unit.

Permeability is slow in this Snead soil, and surface runoff is rapid. Reaction is slightly acid or neutral in the surface layer and ranges from neutral to moderately alkaline in the subsoil. Natural fertility is low, and organic matter content is moderate. The available water capacity is low. The seasonal water table is at a depth of 2 to 3 feet. The shrink-swell potential is high in the subsoil.

Nearly all areas of this complex are in woodland. The complex is generally not suited to cultivated crops and pasture or hay because of the rocks and stones on the surface and in the soil.

This Snead soil is suited to trees, and most areas remain in native hardwoods. The hazard of erosion, restricted use of equipment, seedling mortality, windthrow, and plant competition are concerns in management. Special measures for the control of erosion are needed. Roads and skid trails should be carefully designed and constructed to minimize the steepness and length of slope and avoid the concentration of water. The steep slopes are a hazard for the safe use of equipment. Roads and skid trails should be placed on the contour. Seeding disturbed areas may be necessary after harvest. Direct seeding can be used or seedlings can be planted by hand. Planting special stock of larger size than usual or using container-grown stock may be needed to achieve better survival rates. Lighter, less intensive but more frequent thinnings to reduce the stand density may be necessary to lessen the damage from windthrow. Plant competition for seedlings can be reduced by careful and thorough site preparation, including spraying or cutting. Release treatments may be necessary to ensure development.

This Snead soil generally is unsuited to building site development and onsite waste disposal because of the high shrink-swell potential, stones in the soil, and depth to bedrock.

This Snead-Rock outcrop complex is in capability subclass VIIs.

11C—Greenton silty clay loam, 5 to 9 percent slopes. This deep, moderately sloping, somewhat poorly drained soil is on upland side slopes. This soil commonly is below areas that usually have outcrops of limestone. Individual areas are irregular in shape and range from 5 to 80 acres.

Typically, the surface layer is very dark brown, friable silty clay loam about 5 inches thick. The subsurface layer is also very dark brown, friable silty clay loam about 11 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is very dark grayish brown and dark grayish brown, mottled, firm silty clay loam; the middle part is dark grayish brown, mottled, firm silty clay; and the lower part is mixed dark grayish brown and grayish brown, firm silty clay. In places the combined surface and subsurface layers are less than 10 inches thick.

Included with this soil in mapping are small areas of Oska, Sampsel, and Sharpsburg soils. Oska soils are moderately deep. They are in narrow bands on the lower side slopes. Sampsel soils are grayer than Greenton

soils. They are in small drainageways and are at a lower elevation than Greenton soils. Sharpsburg soils are not so gray and have less clay in the subsoil. They are upslope from Greenton soils. The included soils make up 10 to 15 percent of the map unit.

Permeability is slow in this Greenton soil, and surface runoff from cultivated areas is medium. Reaction ranges from medium acid to neutral in the surface layer. The available water capacity is high. Natural fertility is high, and organic matter content is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet. The surface layer is friable but has a narrow moisture range for tillage operations. It tends to become cloddy if plowed when wet, especially in areas where the plow layer contains subsoil material. The shrink-swell potential is high in the subsoil.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is suited to pasture or hay. The use of the soil for pasture or hay is also an effective means of controlling erosion. This soil is best suited to shallow-rooted legumes and cool-season bunch grasses or to native warm-season grasses. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to building site development and to onsite waste disposal. Septic tanks, however, generally are not suitable for this soil. Areas for sewage lagoons should be leveled by grading and the bottoms of the lagoons sealed to prevent contamination of the ground water. Concrete for footings, foundations, and basement walls for dwellings and small commercial buildings should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. Drainage tile installed at the base of the sand and gravel helps to prevent wet basements. Unless small commerical buildings are designed to fit the slope, some land shaping usually is necessary. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Greenton soil is in capability subclass IIIe.

13B—Sampsel silty clay loam, 2 to 5 percent slopes. This gently sloping, poorly drained soil is on slightly concave foot slopes along drainageways. Individual areas are irregular in shape and range from 10 to about 150 acres.

Typically, the surface layer is black, firm silty clay loam about 7 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is very dark gray, firm silty clay; the middle part is dark grayish brown, mottled, firm silty clay; and the lower part is gray, mottled, firm silty clay.

Included with this soil in mapping are small areas of Greenton and Snead soils. The somewhat poorly drained Greenton soils are on side slopes at a higher elevation than Sampsel soils, and the moderately deep Snead soils are on side slopes along the upper edge of the unit. The included soils make up about 10 percent of the map unit.

Permeability is slow in this Sampsel soil, and surface runoff is medium. Reaction ranges from medium acid to moderately alkaline. Natural fertility is high, and organic matter content is moderate. The available water capacity is moderate. The seasonal high water table ranges from near the surface to a depth of 1.5 feet. The shrink-swell potential is moderate in the surface soil and high in the subsoil. The surface layer is firm and difficult to till. It has a narrow moisture range for tillage operations and tends to become cloddy if tilled when dry and compacted and cloddy if tilled when wet. In addition, this soil may have seepy areas that stay wet most of the year.

Most areas of this soil are used for cultivated crops. The soil is suited to corn, soybeans, and grain sorghums. If this soil is used for cultivated crops, erosion is a hazard and the surface soil may become compacted in seepy areas. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent erosion. Most areas can be farmed on the contour and are suitable for the construction of terraces. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce surface compaction, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. The soil is best suited to shallow-rooted legumes and cool-season bunch grasses or to native warm-season grasses. Because of the natural wetness of this soil and the silty clay loam surface layer, careful management is needed to keep a good stand of grasses and legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the soil and pasture in good condition.

This soil generally is unsuitable for septic tanks because of wetness and slow permeability, and it is limited for sewage lagoons because of depth to rock. Sewage generally can be piped to more suitable adjacent areas. Onsite investigations are needed to

locate suitable sites for sewage lagoons. Concrete for footings, foundations, and basement walls for dwellings and small commercial buildings should be reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent damage caused by shrinking and swelling and excessive wetness. Drainage tile installed at the base of the sand and gravel also helps to prevent damage caused by wetness. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Sampsel soil is in capability subclass IIe.

13C—Sampsel silty clay loam, 5 to 9 percent slopes. This moderately sloping, poorly drained soil is on slightly concave side slopes and foot slopes along drainageways. Individual areas are irregular in shape and range from 10 to about 200 acres.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. The subsurface layer is very dark gray, friable silty clay loam about 7 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is very dark gray, firm silty clay loam; the middle part is dark grayish brown, firm silty clay; and the lower part is grayish brown, firm silty clay.

Included with this soil in mapping are small areas of somewhat poorly drained Greenton soils and moderately deep Snead soils. Greenton soils are upslope from Sampsel soils, and Snead soils are in narrow bands along the upper edge of the unit. The included soils make up 5 to 10 percent of the map unit.

Permeability is slow in this Sampsel soil, and surface runoff is medium. Reaction ranges from medium acid to moderately alkaline. Natural fertility is medium, and organic matter content is moderate. The available water capacity is moderate. A seasonal high water table ranges from near the surface to a depth of 1.5 feet. The shrink-swell potential is moderate in the surface soil and high in the subsoil. The surface layer is friable but difficult to till. It has a narrow moisture range for tillage operations and tends to become cloddy if tilled when dry and cloddy and compacted if tilled when wet. In addition, this soil may have seepy areas that stay wet most of the year.

Most areas of this soil are used for cultivated crops. The soil is suited to corn and soybeans. If this soil is used for cultivated crops, excessive erosion is a hazard and the surface soil may become compacted in seepy areas. The use of conservation tillage, winter cover crops, and grassed waterways helps to prevent erosion. Most areas can be farmed on the contour and are suitable for the construction of terraces. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce surface compaction, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. This soil is best suited to shallow-rooted legumes and cool-season bunch grasses or to native warm-season grasses. Because of the natural wetness of this soil and the silty clay loam surface layer, careful management is needed to keep a good stand of grasses and legumes. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the soil and pasture in good condition.

This soil generally is unsuitable for septic tanks because of wetness and slow permeability, and it is limited for sewage lagoons because of depth to rock and slope. Sewage generally can be piped to more suitable adjacent areas. Onsite investigations are needed to locate sites that have more depth to rock for placement of the sewage lagoons. Some areas can be leveled to reduce the slope if additional soil material is available for the construction of berms. Concrete for footings, foundations, and basement walls for dwellings and small commercial buildings should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundations and basement walls to help prevent damage from shrinking and swelling and wet basements. Drainage tile installed at the base of the sand and gravel also helps to prevent damage caused by wetness. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to provide good drainage and prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Sampsel soil is in capability subclass IIIe.

15B—Menfro silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on narrow, convex ridgetops near streams. Individual areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 4 inches thick. The subsurface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 38 inches thick. It is dark yellowish brown, firm silty clay loam. The substratum to a depth of about 60 inches is dark brown, friable silty clay loam. In places the dark surface layer is 6 to 10 inches thick. In other places grayish brown mottles are at a depth of less than 36 inches.

Included with this soil in mapping are small areas of Sharpsburg, Sibley, and Weller soils. Sharpsburg and Sibley soils have dark surface layers more than 10 inches thick and are on broader ridgetops than the Menfro soils. The moderately well drained Weller soils have more clay in the subsoil and are on ridgetops at a

lower elevation than the Menfro soils. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in this Menfro soil, and surface runoff from cultivated areas is medium. Reaction ranges from strongly acid to neutral. Natural fertility is high, and organic matter content is low. The available water capacity is very high. The surface layer is friable and easily tilled through a fairly wide range in moisture content. It does, however, have a tendency to crust after hard rains. The shrink-swell potential is moderate in the subsoil.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. This soil is suited to alfalfa and smooth bromegrass. Alfalfa needs a high level of fertility. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices are needed. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas remain in woodland. Tree seeds, cuttings, and seedlings survive and grow well. There are no hazards or limitations for planting or harvesting trees.

This soil is suited to building site development and onsite waste disposal. Septic tanks function adequately if properly designed and installed. Areas for sewage lagoons should be leveled by grading and the bottoms of the lagoons sealed with slowly permeable material to prevent seepage. Concrete for foundations and basement walls of dwellings and small commercial buildings should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement wall. Local roads and streets should be graded to shed water, and adequate side ditches should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Menfro soil is in capability subclass IIe.

15C2—Menfro silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, well drained soil is on narrow, convex ridgetops and side slopes. This soil commonly is adjacent to flood plains of tributaries of the Missouri River. Individual areas are irregular in shape and range from 5 to 30 acres.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown and dark brown, firm silty clay loam about 43 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, friable silt loam. In places the upper part of the subsoil has been mixed with the surface soil by plowing and the surface layer is dark yellowish brown silty clay loam. In other places grayish brown mottles are in the lower part of the subsoil.

Included with this soil in mapping are small areas of Oska and Sharpsburg soils. Oska soils have a dark surface layer and are moderately deep to limestone. They commonly are at a lower elevation than the Menfro soils. Sharpsburg soils have a thick, dark surface layer and are farther from the streams. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in this Menfro soil, and surface runoff from cultivated areas is medium. Reaction ranges from strongly acid to neutral. Natural fertility is high, and organic matter content is low. The available water capacity is very high. The surface layer is friable and easily tilled through a fairly wide range in moisture content. It does, however, have a tendency to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material. The shrink-swell potential is moderate in the subsoil.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay and pasture. If the soil is used for cultivated crops, further erosion is a hazard. The use of minimum tillage, winter cover crops, and terraces and grassed waterways helps to prevent excessive soil loss (fig. 13). Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. The soil is suited to alfalfa and smooth bromegrass. Alfalfa needs a high level of fertility. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good management practices are needed for pastures. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas remain in woodland. Tree seeds, cuttings, and seedlings survive and grow well. There are no hazards or limitations for planting or harvesting trees.

This soil is suited to building site development and onsite waste disposal. Septic tanks function adequately if properly designed and installed. Areas for sewage lagoons should be leveled by grading and the bottoms of the lagoons sealed with slowly permeable material to

Figure 13.—Terraces on Menfro silt loam, 5 to 9 percent slopes, eroded.

prevent seepage. Concrete for foundations and basement walls of dwellings and small commercial buildings should be adequately reinforced with steel to prevent damage caused by shrinking and swelling of the soil. Areas to be used for small commercial buildings should be leveled by grading, or the building designed to fit the slope. Local roads and streets should be graded to shed water, and adequate side ditches should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Menfro soil is in capability subclass IIIe.

16D3—Menfro silty clay loam, 9 to 14 percent slopes, severely eroded. This deep, strongly sloping, well drained soil is on side slopes near streams and drainageways. Individual areas are irregular in shape and range from 5 to 25 acres.

Typically, the surface layer is brown silty clay loam about 6 inches thick. The subsoil is about 34 inches thick. It is dark yellowish brown, firm silty clay loam. The substratum to a depth of about 60 inches is dark brown and strong brown silty clay loam. In places the surface layer is silt loam. In other places grayish brown mottles are in the lower part of the subsoil.

Included with this soil in mapping are small areas of Oska and Snead soils. Oska soils have a dark surface layer and are moderately deep to limestone. Snead soils also have a dark surface layer and are moderately deep. Both soils are on side slopes at a lower elevation than the Menfro soils. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in this Menfro soil, and surface runoff from cultivated areas is rapid. Reaction ranges from strongly acid to neutral. Natural fertility is medium, and organic matter content is low. The available water capacity is high. The surface layer is firm and has a narrow optimum moisture range for tillage operations. The shrink-swell potential is moderate.

Most areas of this soil are used for pasture, but a small acreage is used for cultivated crops. The soil is suited to alfalfa and smooth bromegrass. The use of this soil for pasture or hay is an effective means of controlling erosion. Overgrazing or grazing when the soil is wet, however, causes surface compaction, excessive runoff, and poor tilth. Because of the severe hazard of erosion and slope, pasture renovation or seedbed preparation for reestablishing pastures should be accomplished without plowing, or the seedbeds can be placed in strips on the contour. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

If this soil is used for cultivated crops, further erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is well suited to trees, and a few small areas remain in woodland. Tree seeds, cuttings, and seedlings survive and grow well. There are no hazards or limitations for planting or harvesting trees.

This soil is suited to building site development and onsite waste disposal. Land shaping and installing lines across the slope generally are necessary for the proper operation of septic tank filter fields. Areas for sewage lagoons should be leveled by grading and the bottoms of the lagoons sealed with slowly permeable material to prevent seepage. Concrete for foundations and basement walls of dwellings should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent damage caused by shrinking and swelling of the soil. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Menfro soil is in capability subclass IVe.

17B—Polo silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on convex ridgetops. Individual areas are long and narrow and range from 5 to 60 acres.

Typically, the surface layer is very dark brown, friable silt loam about 6 inches thick. The subsurface layer is very dark brown, friable silt loam about 8 inches thick. The subsoil extends to a depth of 67 inches or more. The upper part is very dark grayish brown and dark brown, firm silty clay loam; the middle part is brown, firm silty clay loam; and the lower part is yellowish red, firm silty clay loam.

Included with this soil in mapping are small areas of Oska and Sibley soils. Oska soils are moderately deep. They are at a lower elevation than Polo soils. Sibley soils have more clay and are not so red in the lower part of the subsoil as Polo soils. They are on side slopes at a higher elevation. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in this Polo soil, and surface runoff from cultivated areas is medium. Reaction is slightly acid or medium acid in the surface layer. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. The surface layer is friable and easily worked through a fairly wide range in moisture content. It does, however, have a tendency to crust or puddle after hard rains. The shrink-swell potential is moderate in the subsoil.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. The soil is suited to alfalfa and smooth bromegrass. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to building site development and onsite waste disposal. Septic tank filter fields need to be larger than are commonly used because of the moderate permeability of the soil. Areas for sewage lagoons should be leveled by grading and the bottoms of the lagoons sealed with slowly permeable material to prevent seepage. Concrete for foundations and basement walls should be reinforced with steel and a layer of sand and gravel placed around the foundation and basement walls to prevent structural damage. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by the shrinking and swelling of the soil and frost action. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Polo soil is in capability subclass IIe.

17C2—Polo silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, well drained soil is on convex side slopes. Individual areas are irregular in shape and range from 5 to 40 acres.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is dark brown, firm silty clay loam; the middle part is brown, firm silty clay loam; and the lower part is reddish brown and yellowish red, firm silty clay loam. In places the upper part of the subsoil has been mixed with the surface layer by plowing and the surface layer is dark brown silty clay loam.

Included with this soil in mapping are areas of Snead soils and small areas of Oska and Sibley soils. Snead soils are on the steeper slopes. Both Oska and Snead soils are moderately deep and are downslope from Polo soils. Sibley soils have less clay and are not so red in the lower part of the subsoil as Polo soils. They are upslope from Polo soils. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderate in this Polo soil, and surface runoff from cultivated areas is medium. Natural fertility and organic matter content are moderate. The available water capacity is high. Reaction is slightly acid or medium acid in the surface layer. The surface layer is friable and easily worked through a fairly wide range of moisture conditions. It does, however, have a tendency to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material. The shrink-swell potential is moderate in the subsoil and high in the substratum.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, further erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. This soil is well suited to alfalfa and smooth bromegrass. Alfalfa needs a high fertility level. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices are needed. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during

wet periods help to keep the pasture and soil in good condition.

This soil has limitations for building site development. Sewage lagoons should be placed on less sloping areas. An onsite investigation is needed to determine the depth to bedrock before areas are leveled to reduce the slope. Septic tanks function adequately if proper design and installation procedures are used, but the filter field needs to be made larger than is commonly used because of the moderate permeability of the soil. Concrete for basement walls, foundations, and footings for dwellings and small commercial buildings should be properly designed and reinforced with steel and a layer of sand and gravel placed around the foundation or basement wall to prevent structural damage caused by shrinking and swelling of the soil. Small commercial buildings should be designed to fit the slope, or the land should be leveled to reduce the slope. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by shrinking and swelling of the soil and frost action. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Polo soil is in capability subclass IIIe.

19B—Weller silt loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops. Individual areas are irregular in shape and range from 8 to 50 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsurface layers are about 14 inches thick. The upper part is dark grayish brown, friable silt loam, and the lower part is brown, friable silt loam. The subsoil is about 39 inches thick. The upper part is yellowish brown, firm silty clay loam; the middle part is mottled dark grayish brown and strong brown, firm silty clay loam; and the lower part is mottled grayish brown, yellowish brown, and light brownish gray, firm silty clay loam. The substratum to a depth of about 70 inches is mottled grayish brown and strong brown, firm silty clay loam.

Included with this soil in mapping are small areas of Greenton, Macksburg, and McGirk soils. Greenton soils have a thicker, dark surface layer than Weller soils, and they are at the heads of drainageways at a higher elevation. The somewhat poorly drained Macksburg soils are on broader ridgetops at a higher elevation, and the poorly drained McGirk soils are on more sloping areas at a lower elevation than Weller soils. The included soils make up 5 to 10 percent of the map unit.

Permeability is slow in this Weller soil, and surface runoff from cultivated areas is medium. Reaction ranges from very strongly acid to slightly acid. Natural fertility is high, and organic matter content is low. The available water capacity is high. The seasonal high water table is at a depth of 2 to 4 feet. The surface layer is friable and easily tilled through a fairly wide range in moisture content. It does, however, have a tendency to crust or puddle after hard rains. The shrink-swell potential is high.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage and winter cover crops helps to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. This soil is best suited to shallow-rooted legumes and cool-season bunch grasses or to native warm-season grasses. Good pasture management practices are needed. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Seedling mortality and windthrow are management concerns. Planting stock of larger size than usual helps to achieve better survival rates. Frequent, less intensive thinnings reduce the stand density and minimize the damage from windthrow.

This soil is suited to building site development and onsite waste disposal. Septic tanks do not function adequately, however, because of wetness and slow permeability in the soil. Areas for sewage lagoons should be leveled by grading. Concrete for footings, foundations, and basement walls for dwellings and small commercial buildings should be reinforced with steel and a backfill of sand and gravel placed around the foundation and basement wall to prevent damage caused by shrinking and swelling of the soil. Drainage tile installed at the base of the sand and gravel helps to prevent damage caused by excessive wetness. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by frost action, wetness, and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Weller soil is in capability subclass IIIe.

20C2—McGirk silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, poorly drained soil is on concave side slopes at the heads of drainageways. Individual areas are irregular in shape and range from 5 to 40 acres.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 51 inches thick. The upper part is dark grayish brown, firm silty clay loam; the middle part is grayish brown and dark grayish brown, mottled, very firm silty clay; and the lower

part is gray, mottled, very firm silty clay. The substratum to a depth of about 66 inches is gray, mottled, firm silty clay loam. In places erosion has removed all of the original silt loam surface layer and the present layer is brown silty clay loam.

Included with this soil in mapping are small areas of Greenton and Weller soils. Greenton soils have a thick, dark surface layer and are at the heads of drainageways. Weller soils are moderately well drained and are on ridgetops. Both soils are at a higher elevation than McGirk soils. The included soils make up about 5 percent of the map unit.

Permeability is slow in this McGirk soil, and surface runoff from cultivated areas is medium. Reaction is medium acid or strongly acid in the surface layer. Natural fertility is medium, and organic matter content is low. The available water capacity is moderate. The seasonal high water table is at a depth of 1 foot to 3 feet. The surface layer is friable and easily tilled through a narrow range in moisture content. It does, however, have a tendency to crust or puddle after hard rains, especially in areas where the plow layer contains subsoil material. The shrink-swell potential is high in the subsoil.

Most areas of this soil are used for cultivated crops. A small acreage is used for pasture and woodland. This soil is moderately suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, further erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. The soil is best suited to shallow-rooted legumes and cool-season bunch grasses or to native warm-season grasses. Good pasture management practices are needed. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and a few small areas remain in native hardwoods. Frequent but less intensive thinnings to reduce the stand density may be needed to minimize the damage from windthrow. Planting stock of larger size than usual helps to achieve better seedling survival rates. There are only slight hazards or limitations for harvesting trees.

This soil is suited to building site development and onsite waste disposal. Septic tank absorption fields do not function properly, however, because of wetness and slow permeability in the soil. Areas for sewage lagoons need to be leveled by grading. Concrete for footings, foundations, and basement walls for dwellings and small commercial buildings should be reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. Drainage tile installed at the base of the sand and gravel helps to prevent damage caused by excessive wetness. Local roads and street should be graded to shed water, and adequate side ditches should be installed to prevent damage caused by frost action, wetness, and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This McGirk soil is in capability subclass IVe.

22C2—Oska silty clay loam, 5 to 9 percent slopes, eroded. This moderately deep, moderately sloping, well drained soil is on upland side slopes. This soil commonly is above rock ledges and steeper slopes. Individual areas are irregular in shape and range from 5 to 55 acres.

Typically, the surface layer is dark brown, friable silty clay loam about 3 inches thick. The subsoil is about 31 inches thick. The upper part is dark reddish brown, friable silty clay loam; the middle part is reddish brown, firm silty clay loam and brown, firm gravelly silty clay; and the lower part is brown and yellowish brown, firm silty clay loam underlain by hard limestone bedrock. In places limestone and flintstone fragments are at the surface and throughout the soil profile. In other places the soil is deeper than is allowed for the Oska series.

Included with this soil in mapping are small areas of Polo, Sampsel, Sharpsburg, and Snead soils. The deep Polo and Sharpsburg soils are upslope from Oska soils. The deep Sampsel soils are generally in drainageways and are downslope from Oska soils. The moderately well drained, flaggy Snead soils are commonly on steeper slopes and are downslope from Oska soils. The included soils make up 5 to 10 percent of the map unit.

Permeability is slow in this Oska soil, and surface runoff is medium. Reaction is medium acid or slightly acid in the surface layer. Natural fertility is medium, and organic matter content is moderate. The available water capacity is low. The surface layer is friable but is difficult to till and has a tendency to clod if tilled at too high a moisture content. The shrink-swell potential is high in the subsoil.

Most areas of this soil are used for pasture or hay. Small areas are used for cultivated crops. This soil is suited to alfalfa, smooth bromegrass, and native warm-season grasses. The use of the soil for pasture or hay is also an effective means of controlling erosion. Alfalfa needs a high level of fertility. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good management practices are needed. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation,

and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, further erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is suited to building site development and onsite waste disposal. Septic tank mound filter fields function adequately if a suitable soil material is used over the bedrock. As an alternative, sewage can be piped to adjacent areas where the soils are more suitable for waste disposal. Concrete for footings, foundations, and basement walls for dwellings and small commercial buildings should be reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. The rock will need to be excavated, or the basement can be set on top of the rock and the soil mounded around it. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to prevent damage caused by shrinking and swelling of the soil and frost action. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Oska soil is in capability subclass IVe.

30—Kennebec silt loam. This deep, nearly level, moderately well drained soil is on flood plains adjacent to the stream channels of small or medium streams. This soil is subject to occasional flooding unless it is protected by levees. Individual areas are irregular in shape and range from 5 to 80 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is about 30 inches thick. The upper part is very dark grayish brown, friable silt loam, and the lower part is black, friable silty clay loam. The next layer is very dark grayish brown, friable silty clay loam about 17 inches thick. The substratum to a depth of about 60 inches is very dark grayish brown, friable silt loam.

Included with this soil in mapping are small areas of Colo and Zook soils. Colo soils are poorly drained. They are between the Kennebec soils and the uplands farther back from the main stream channel. Zook soils are also poorly drained. They have more clay in the subsoil than Kennebec soils and are on broad flat flood plains. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in this Kennebec soil, and surface runoff is slow. Reaction ranges from medium acid to neutral in the surface layer. Natural fertility and organic matter content are high. The available water capacity is very high. A seasonal high water table is at a depth of 3 to 5 feet. The surface layer is friable and easily tilled through a fairly wide range in moisture content. The shrink-swell potential is moderate.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, soybeans, small grains, and grasses and legumes for pasture and hay if it is protected from flooding. If the soil is used for cultivated crops or small grains, the plantings in depressional areas may drown out during periods of flooding. Land grading, shallow surface drainage, and open ditches help to remove excess water. Returning crop residue or the regular addition of other organic matter helps to improve fertility and increase water infiltration.

This soil is well suited to alfalfa and smooth bromegrass if it is protected from flooding. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but very little acreage is in woodland. Plant competition is a concern in management. Competition for seedlings can be reduced by careful and thorough site preparation, including prescribed burning, spraying, or cutting. Release treatment may be necessary to ensure development.

This soil generally is unsuited to building site development and onsite sanitary facilities because of flooding.

This Kennebec soil is in capability subclass IIw.

31—Colo silty clay loam. This deep, nearly level, poorly drained soil is on bottom lands adjacent to small streams. It is subject to occasional flooding unless protected by levees. Individual areas are long and moderately wide and range from 20 to 100 acres or more.

Typically, the surface layer is very dark gray, friable silty clay loam about 6 inches thick. The subsurface layer is black, firm silty clay loam about 17 inches thick. The subsoil is black and very dark gray, firm silty clay loam about 24 inches thick. The substratum to a depth of about 63 inches is very dark gray, firm silty clay loam. In places the subsurface layer has more clay.

Included with this soil in mapping are small areas of moderately well drained Kennebec soils. Kennebec soils are between Colo soils and the stream channels. The included soils make up about 5 percent of the map unit.

Permeability is moderate in this Colo soil, and surface runoff is slow. Reaction ranges from medium acid to neutral in the surface layer and is neutral or slightly acid in the underlying material. Natural fertility, available water capacity, and organic matter content are high. A seasonal high water table is at a depth of 1 foot to 3 feet. The surface layer is friable, but care should be taken not to till the soil when it is wet. If worked when wet, this soil has a tendency to become compacted and

Figure 14.—Corn and soybeans on Colo silty clay loam.

cloddy. Root development may be restricted below a depth of about 24 inches during wet years because of a seasonal high water table. The shrink-swell potential is high.

Most areas of this soil are used for cultivated crops (fig. 14). This soil is suited to corn, soybeans, small grains, and grasses and legumes for pasture and hay. If the soil is used for cultivated crops and small grains, flooding caused by slow runoff is a hazard. Land grading and the use of open ditches and shallow surface drainage help to remove excess water quickly. Levees help to prevent flooding. Returning crop residue or the regular addition of other organic material helps to improve fertility, keep the surface friable, and increase water infiltration.

This soil generally is unsuited to building site development and onsite waste disposal because of flooding.

This Colo soil is in capability subclass IIw.

33—Zook silty clay loam. This deep, nearly level, poorly drained soil is on wide flood plains of tributaries to the Missouri River. This soil is subject to occasional flooding if it is not protected by levees. Individual areas are long and moderately wide and range from about 10 to 140 acres.

Typically, the surface layer is black, friable silty clay loam about 8 inches thick. The subsurface layers are about 33 inches thick. The upper part is black, firm silty clay loam, and the lower part is black, firm silty clay. The subsoil is dark gray, firm silty clay about 11 inches thick. The substratum to a depth of about 60 inches is dark gray, firm silty clay. In some places less clay is in the subsurface layers, and in other places more clay is in the subsurface layers.

Included with this soil in mapping are small areas of moderately well drained Kennebec soils. Kennebec soils are between the stream channel and Zook soils. The included soils make up about 5 percent of the map unit.

Permeability is slow in this Zook soil, and surface runoff is slow. Reaction is medium acid or slightly acid. Natural fertility and organic matter content are high. The available water capacity is moderate. The seasonal high water table is at a depth of 1 foot to 3 feet. The surface layer is friable, but the soil has a narrow moisture range for tillage operations. It has a tendency to become cloddy and compacted if tilled when wet. The shrink-swell potential is high.

Nearly all areas of this soil are used for cultivated crops. Only a few isolated areas are used for pasture or hay. This soil is suited to soybeans, corn, grain sorghum, and small grains. Wetness is a major hazard on this soil, and crops planted in depressional areas may drown out.

Land grading and the use of shallow surface drainage and open ditches help to remove excess water. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil generally is unsuited to building site development and onsite waste disposal because of the hazard of flooding and wetness.

This Zook soil is in capability subclass IIw.

36—Bremer silt loam. This deep, nearly level, poorly drained soil is on low terraces along streams. This soil is subject to occasional flooding unless it is protected by levees. Individual areas are irregular in shape and range from 5 to 30 acres.

Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer is black, friable silty clay loam about 13 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is very dark gray and dark gray, mottled, firm silty clay loam; the middle part is dark grayish brown, firm silty clay loam; and the lower part is multicolored, firm silty clay loam. In places the subsoil has less clay. In other places the dark soil layers extend to a depth of more than 36 inches.

Permeability is moderately slow in this Bremer soil, and surface runoff is slow. Reaction ranges from neutral to medium acid in the surface layer. Natural fertility, organic matter content, and available water capacity are high. The seasonal high water table is at a depth of 1 foot to 3 feet. Although the surface layer is friable, this soil becomes cloddy and the surface crusts if it is tilled when the moisture content is high. The shrink-swell potential is high.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghums, and small grains. If the soil is used for cultivated crops, drainage is needed in the depressional areas. Land grading and the use of shallow surface drains and open ditches help to remove excess water. Diversion terraces may be needed to intercept runoff from adjacent areas. Returning crop residue or the regular addition of other organic matter helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is suited to trees, but very little acreage is in woodland. Restricted use of equipment, seedling mortality, windthrow, and plant competition are concerns in management. Equipment operations should be timed for periods when the soil is dry or frozen. Ridging the soil and planting on the ridges help to increase the chances of seedling survival. Lighter, less intensive, but more frequent thinnings to reduce the stand density may be needed to minimize the damage from windthrow. Plant competition for seedlings can be reduced by careful and thorough site preparation, including prescribed burning, spraying, or cutting. Release treatments may be necessary to ensure development.

This soil generally is unsuited to building site development and onsite waste disposal because of flooding and wetness.

This Bremer soil is in capability subclass IIw.

38—Wiota silt loam. This deep, nearly level, well drained soil is on stream terraces of tributaries to the Missouri River. This soil is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 40 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is black, friable silt loam about 6 inches thick. The subsoil is about 34 inches thick. The upper part is very dark grayish brown, friable silty clay loam; the middle part is dark brown, friable silty clay loam; and the lower part is dark yellowish brown, friable silty clay loam. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, friable silty clay loam.

Included with this soil in mapping are small areas of Bremer, Kennebec, and Napier soils. Bremer soils have higher clay content than Wiota soils and are at a slightly lower elevation. Kennebec soils have dark soil layers more than 36 inches thick and are in lower positions on the flood plain. Napier soils have thicker dark layers in the upper part of the profile and less clay in the subsoil. They are on toe slopes. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in this Wiota soil, and surface runoff is medium. Reaction ranges from slightly acid to strongly acid. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. The surface layer is friable and easily tilled through a fairly wide range in moisture content. The shrink-swell potential is moderate.

Most areas of this soil are used for cultivated crops, but a small acreage is used for pasture and hay. This soil is suited to corn, soybeans, small grains, and grain sorghums. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is suited to grasses and legumes for pasture and hay. It is well suited to alfalfa and smooth bromegrass. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil generally is unsuitable for building site development and onsite waste disposal because of the hazard of flooding.

This Wiota soil is in capability class I.

47D—Mandeville silt loam, 5 to 14 percent slopes. This moderately deep, moderately sloping and strongly sloping, moderately well drained soil is on ridgetops and

convex side slopes. Individual areas range from 10 to 100 acres.

Typically, the surface layer is dark grayish brown and very dark grayish brown silt loam about 4 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil is about 14 inches thick. The upper part is brown, friable silty clay loam; the middle part is dark yellowish brown, friable silty clay loam; and the lower part is dark yellowish brown, mottled, friable silty clay loam. Yellowish brown, soft weathered shale is at a depth of about 21 inches.

Included with this soil in mapping are small areas of Menfro and Snead soils. Menfro soils are deeper to bedrock than Mandeville soils. They are upslope from the Mandeville soils. Snead soils have a thick, dark surface layer. They are in positions similar to those of the Mandeville soils. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in this Mandeville soil, and surface runoff is medium. The available water capacity is low. Natural fertility is low, and organic matter content is moderately low. The seasonal high water table is at a depth of 2 to 3 feet. The surface layer is friable and easily tilled. Reaction ranges from very strongly acid to medium acid. The shrink-swell potential is low.

Most areas of this soil are used for pasture, hay, and woodland. This soil is suited to shallow-rooted legumes and cool-season bunch grasses. The use of the soil for pasture and hay is an effective means of controlling erosion. Overgrazing or grazing when the soil is wet causes surface compaction and excessive runoff and damages the stand. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and a few areas remain in native hardwoods. The problems in management are slight.

This soil is poorly suited to corn, soybeans, grain sorghums, and small grains. If this soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent erosion. Returning crop residue or the regular addition of other organic material helps to improve fertility, increase available water capacity, and reduce erosion.

This soil is suited to building site development and onsite waste disposal. Increasing the depth of suitable soil material over the bedrock in a properly constructed mound helps to make this soil suitable for septic tank filter fields. The bedrock should be excavated to construct dwellings with basements, or the building can be set on the bedrock and the soil shaped around the building. Installing drainage tile around footings and foundations helps to prevent damage caused by excessive wetness. Local roads and streets should be graded to shed water, and adequate side ditches and culverts should be installed to help prevent damage caused by frost action. Adding crushed rock or other suitable material strengthens the base material.

This Mandeville soil is in capability subclass IVe.

54C—Knox silt loam, 5 to 9 percent slopes. This deep, moderately sloping, well drained soil is on dissected uplands bordering the Missouri River Valley and its tributaries. Individual areas are irregular in shape and range from 5 to 80 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil is dark yellowish brown, friable silty clay loam about 49 inches thick. The upper part is firm, and the lower part is friable. The substratum to a depth of about 71 inches is dark yellowish brown silt loam. In places the slopes are less than 5 percent.

Included with this soil in mapping are small areas of Higginsville and Sibley soils. Higginsville soils are somewhat poorly drained and are at the heads of drainageways. Sibley soils have a thick, dark surface layer and are on wider ridgetops. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in this Knox soil, and surface runoff from cultivated areas is medium. Reaction ranges from neutral to medium acid. Natural fertility is high, and available water capacity is very high. The organic matter content is moderately low. The surface layer is friable and easily tilled through a fairly wide range in moisture content but tends to crust or puddle after hard rains. The shrink-swell potential is moderate in the subsoil.

Most areas of this soil are used for cultivated crops, but a small acreage is in pasture and woodland. This soil is suited to corn, soybeans, small grains, and grain sorghums. If the soil is used for cultivated crops, erosion is a hazard. The use of minimum tillage, winter cover crops, and grassed waterways helps to reduce soil loss by erosion. Most areas can be terraced and farmed on the contour. Returning crop residue or the regular addition of other organic material helps to improve fertility and increase water infiltration.

The use of this soil for pasture or hay is an effective means of controlling erosion. The soil is well suited to alfalfa and smooth bromegrass. Alfalfa needs a high level of fertility. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices should be used. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees, and a few small areas remain in native hardwoods. Tree seeds, cuttings, and seedlings survive and grow well. There are only slight

Figure 15.—Apple orchard on Knox silt loam, 5 to 9 percent slopes.

limitations for planting or harvesting trees. This soil is well suited to orchards, and a small acreage is used for the production of apples and peaches (fig. 15).

This soil is suited to building site development and onsite waste disposal. Septic tanks function adequately if designed and installed properly. Sewage lagoons should be constructed on the less sloping areas, or the area should be leveled to reduce the slope. Sealing the bottom of the lagoon with slowly permeable material helps to prevent seepage. Concrete for footings, foundations, and basement walls for dwellings and small commercial buildings should be reinforced with steel and a backfill of sand placed around the foundation and basement walls to help prevent damage caused by shrinking and swelling of soil. Areas for small commercial buildings should be leveled by grading, or the buildings should be designed to fit the slope. Local roads and streets have limitations because of low strength, shrink-swell potential, and frost action. Adding crushed rock or other suitable material helps to compensate for the low strength. Grading the roads to shed water and installing adequate side ditches and culverts help to prevent damage caused by shrinking and swelling of the soil and frost action.

This Knox soil is in capability subclass IIIe.

54E—Knox silt loam, 14 to 20 percent slopes. This deep, moderately steep, well drained soil is on dissected river hills and bluffs bordering the Missouri River Valley and its tributaries. Individual areas are irregular in shape and range from 5 to 120 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 42 inches thick. The upper part is brown, friable silty clay loam, and the lower

part is dark yellowish brown, friable silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, friable silt loam. In places the slopes are more than 20 percent. In other places all of the original surface layer has been removed by erosion and the surface layer is brown silty clay loam.

Included with this soil in mapping are small areas of moderately well drained Kennebec soils and moderately deep Snead soils. Kennebec soils are in the narrow stream bottoms, and Snead soils are on side slopes at a lower elevation than Knox soils. The included soils make up 2 to 5 percent of the map unit.

Permeability is moderate in this Knox soil, and surface runoff is rapid. Reaction ranges from neutral to medium acid. Natural fertility is high, and organic matter content is moderately low. The available water capacity is very high. The shrink-swell potential is moderate in the subsoil.

Most areas of this soil are used for pasture and woodland. The use of the soil for pasture or hay is an effective means of preventing erosion. This soil is well suited to alfalfa and smooth bromegrass. Alfalfa needs a high level of fertility. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Reestablishment or renovation should be accomplished without plowing, or tillage operations should be made on the contour in strips. Good management practices are needed for pasture. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, and a few areas remain in native hardwoods. Erosion, restricted use of equipment, and seedling mortality are concerns in management. Roads and skid trails should be carefully designed to control erosion. Construction of such roads should minimize the steepness and length of slopes and avoid the concentration of water. Steep slopes are a hazard for safe use of equipment. Roads and skid trails should be placed on the contour. The seeding of disturbed areas may be necessary after harvest. Seedlings can be planted by hand, or the area can be seeded directly. Planting stock of larger size than usual or using container-grown stock may be necessary to achieve a better rate of survival.

This soil is suited to building site development and onsite waste disposal. Land shaping and installing lines across the slope generally are necessary for the proper operation of septic tank filter fields. Sewage lagoons should be placed on the less sloping areas, or the area can be leveled and sealed with slowly permeable material to prevent seepage. Dwellings should be designed to fit the natural slope or land shaped to reduce the slope. Concrete for foundations and basement walls should be adequately reinforced with steel and a layer of sand and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. Local roads and streets should be placed on the contour. They should be graded to shed water, and adequate side ditches should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Knox soil is in capability subclass IVe.

54F—Knox silt loam, 20 to 30 percent slopes. This deep, steep, well drained soil is on deeply dissected uplands bordering the Missouri River Valley and its tributaries. Individual areas are irregular in shape and range from 15 to 150 acres.

Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is about 33 inches thick. The upper part is brown, friable silty clay loam, and the lower part is dark yellowish brown, friable silty clay loam. The substratum to a depth of about 60 inches is dark yellowish brown, friable silt loam. In places the slopes are more than 30 percent.

Included with this soil in mapping are small areas of moderately well drained Kennebec soils and moderately deep Snead soils. Kennebec soils are on small stream bottoms. Snead soils are on side slopes at a lower elevation than the Knox soils. The included soils make up about 5 percent of the map unit.

Permeability is moderate in this Knox soil, and surface runoff is very rapid. The available water capacity is very high. The shrink-swell potential is moderate in the subsoil. Reaction ranges from neutral to medium acid. Natural fertility is high, and organic matter content is moderately low.

Most areas of this soil are in woodland. This soil is suited to grasses and legumes for pasture. Because of the steep slope and the severe hazard of erosion, care should be used in reestablishing the pasture. Renovation should be accomplished without plowing, or the seedbed should be prepared in strips on the contour to reduce the erosion hazard. Good management practices should be used to maintain existing stands of grass. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees. Most areas have an existing stand of native hardwoods, but the trees are of low quality. Harvesting of timber is difficult because of the steep slopes. Yarding the logs uphill to logging roads and skid trails may be necessary. Erosion is a limitation. Logging roads and skid trails should be placed on the contour. Seeding of disturbed areas may be needed after harvest. Planting the seedlings by hand or direct seeding methods can be used to offset the steep slopes.

Planting stock of larger size than usual may be necessary to achieve better survival rates.

This soil generally is unsuited to building site development and onsite waste disposal because of steep slopes.

This Knox soil is in capability subclass VIe.

55D3—Knox silty clay loam, 5 to 14 percent slopes, severely eroded. This deep, moderately sloping and strongly sloping, well drained soil is on dissected hills and bluffs bordering the Missouri River Valley and its tributaries. Individual areas are irregular in shape and range from 5 to 60 acres.

Typically, the surface layer is brown, friable silty clay loam about 3 inches thick. The subsoil is about 26 inches thick. It is dark yellowish brown, friable silty clay loam. The substratum to a depth of about 60 inches is yellowish brown and dark yellowish brown, friable silt loam. In places the original dark grayish brown silt loam surface layer is still present.

Included with this soil in mapping are small areas of Higginsville and Sibley soils. Higginsville soils are somewhat poorly drained. They are at the heads of drainageways. Sibley soils have a thick, dark surface layer. They are on wide ridgetops at a higher elevation than the Knox soils. The included soils make up 2 to 5 percent of the map unit.

Permeability is moderate in this Knox soil, and surface runoff is rapid. Natural fertility is medium, and organic matter content is low. The available water capacity is high. The shrink-swell potential is moderate in the subsoil. Reaction ranges from neutral to medium acid in the surface layer. This soil is easily tilled only through a rather limited range in moisture content. It tends to become cloddy if tilled when wet.

Most areas of this soil are used for cultivated crops. A small acreage is used for pasture and woodland. This soil is suited to limited production of cultivated crops, but further erosion is a hazard if the soil is cultivated. Clean-tilled crops should be grown only about 20 percent of the time. The use of minimum tillage, winter cover crops, and grassed waterways helps to prevent excessive soil loss. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

The use of this soil for pasture or hay is also an effective means of controlling erosion. The soil is well suited to alfalfa and smooth bromegrass. A high level of fertility is needed for alfalfa. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices are needed. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is well suited to trees. Tree seeds, cuttings, and seedlings survive and grow well. There are only slight limitations for planting or harvesting trees.

This soil is suited to building site development and onsite waste disposal. Septic tank filter fields should be designed to operate on the slope. Sewage lagoons should be placed on less sloping areas, or the area should be leveled. The bottoms of the lagoons may need to be sealed with slowly permeable material to prevent seepage. Foundations and basement walls for dwellings should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. Some land shaping generally is needed, or the dwelling should be designed to fit the natural slope. Local roads and streets should be graded to shed water, and adequate side ditches should be installed to prevent damage caused by frost action and shrinking and swelling of the soil. Adding crushed rock or other suitable material helps to prevent damage caused by low strength.

This Knox soil is in capability subclass IVe.

60B—Sibley-Urban land complex, 2 to 5 percent slopes. This complex consists of deep, gently sloping, well drained Sibley soil and Urban land on moderately wide, convex ridges. Individual areas are irregular in shape and range from 40 to 700 acres. This complex is about 60 percent Sibley soil and 35 percent Urban land. The Sibley soil and Urban land are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Sibley soil has a surface layer of very dark brown, friable silt loam about 6 inches thick. The subsurface layers are very dark brown, friable silt loam and very dark grayish brown, friable silty clay loam about 17 inches thick. The subsoil is firm silty clay loam about 42 inches thick. The upper part is dark brown; the middle part is brown; and the lower part is dark yellowish brown and mottled. The substratum to a depth of about 76 inches is mottled grayish brown and yellowish brown, friable silt loam. In places, the dark soil layers are less than 24 inches thick and the grayish brown mottles are at a depth of less than 36 inches.

The Urban land part of this complex is covered by streets, driveways, parking lots, buildings, and other structures. These structures obscure or alter the soils so that identification of the soil series is not feasible.

Included with the Sibley soil and Urban land in mapping are small areas of Macksburg soils. Macksburg soils are somewhat poorly drained and are on the broader ridgetops. The included soils make up about 5 percent of the map unit.

Permeability is moderate in this Sibley soil, and surface runoff is medium. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. The shrink-swell potential is moderate.

The Sibley soil is well suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens and to some recreational uses. It has moderate limitations for use as playgrounds. Areas to be used for playgrounds should be leveled to modify the slope.

The Sibley soil is suited to building site development. All sanitary facilities should be connected to commercial sewers. The shrink-swell potential is a limitation for dwellings and small commercial buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to prevent structural damage. Roads and streets generally are already available.

This Sibley-Urban land complex is not assigned to a capability subclass.

60C—Sibley-Urban land complex, 5 to 9 percent slopes. This complex consists of deep, moderately sloping, well drained Sibley soil and Urban land on moderately wide, convex side slopes. Individual areas are irregular in shape and range from 40 to 500 acres. This complex is about 60 percent Sibley soil and 35 percent Urban land. The Sibley soil and Urban land are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Sibley soil has a surface layer of very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is about 19 inches thick. It is dark brown, friable silt loam in the upper part and very dark grayish brown, friable silty clay loam in the lower part. The subsoil is about 39 inches thick. The upper part is very dark brown, friable silty clay loam, and the lower part is dark yellowish brown, friable silty clay loam. The substratum to a depth of about 70 inches is dark yellowish brown, friable silt loam. In places the dark soil layers are less than 24 inches thick and grayish brown mottles are at a depth of less than 36 inches.

The Urban land part of this complex is covered by streets, driveways, parking lots, buildings, and other structures. These structures obscure or alter the soil so that identification of the soil series is not feasible.

Included with this Sibley soil and Urban land in mapping are small areas of Higginsville and Polo soils. Higginsville soils are somewhat poorly drained. They are on slightly concave slopes at the heads of drainageways. Polo soils have more clay in the subsoil than Sibley soil, and they are on side slopes at a lower elevation. The included soils make up about 5 percent of the map unit.

Permeability is moderate in this Sibley soil, and surface runoff is rapid. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. The shrink-swell potential is moderate.

The Sibley soil is well suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens and to some recreational uses. Some places may need leveling to modify the slope for use as picnic areas and playgrounds.

The Sibley soil is suitable for building site development. All sanitary facilities should be connected to commercial sewers. The shrink-swell potential is a limitation for dwellings and small commercial buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent structural damage. Roads and streets generally are already available.

This Sibley-Urban land complex is not assigned to a capability subclass.

61C—Knox-Urban land complex, 5 to 9 percent slopes. This complex consists of deep, moderately sloping, well drained Knox soil and Urban land on narrow, convex ridges. Individual areas are long and narrow and range from 25 to 500 acres. This complex is about 60 percent Knox soil and 35 percent Urban land. The Knox soil and Urban land are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Knox soil has a surface layer of very dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is brown, friable silt loam about 5 inches thick. The subsoil to a depth of about 49 inches is friable silty clay loam. It is dark yellowish brown in the upper part and brown in the lower part. The substratum to a depth of about 71 inches is brown silt loam. In places the surface layer has been removed during land shaping, and in other places dark yellowish brown fill material has been graded in over the surface layer. In some places this complex occurs on ridgetops and the slope is less than 5 percent.

The Urban land part of this complex is covered by streets, parking lots, buildings, and other structures that obscure or alter the soils so that identification of the soil series is not feasible.

Permeability is moderate in this Knox soil, and surface runoff is rapid. Natural fertility is high, and organic matter content is moderately low. The available water capacity is very high. The shrink-swell potential is moderate in the subsoil.

The Knox soil is well suited to lawn grasses, shade and ornamental trees, shrubs, vines, and vegetable gardens and to some recreational uses. Some places should be leveled to reduce the slope for use as playgrounds and picnic areas.

The Knox soil is suited to building site development. All sanitary facilities should be connected to commercial sewers. The shrink-swell potential is a limitation for dwellings and small commercial buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent structural damage. Roads and streets generally are already available.

This Knox-Urban land complex is not assigned to a capability subclass.

61D—Knox-Urban land complex, 9 to 14 percent slopes. This complex consists of deep, strongly sloping, well drained Knox soil and Urban land on convex side slopes. Individual areas are irregular in shape and range from 20 to 350 acres. This complex is about 55 to 65 percent Knox soil and 20 to 30 percent Urban land. The Knox soil and Urban land are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Knox soil has a surface layer of brown, friable silty clay loam about 3 inches thick. The subsoil is about 26 inches thick. It is dark yellowish brown, friable silty clay loam. The substratum to a depth of 60 inches is yellowish brown and dark yellowish brown, friable silt loam. In places dark yellowish brown fill material has been graded in over the surface layer during land shaping. In other places the subsoil is higher in clay content. In some places the slope is more than 14 percent.

The Urban land part of this complex is covered by streets, parking lots, buildings, and other structures. These structures obscure or alter the soils so that identification of the soil series is not feasible.

Included with this Knox soil and Urban land in mapping are small areas of Snead soils. Snead soils are moderately deep and are on the lower part of the slope. The included soils make up about 5 percent of the map unit.

Permeability is moderate in this Knox soil, and surface runoff is rapid. Natural fertility is high, and organic matter content is low. The available water capacity is high. The shrink-swell potential is moderate in the subsoil.

The Knox soil is well suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens and to some recreational uses. Places to be used for picnic areas and playgrounds should be leveled to reduce the slope.

The Knox soil is suited to building site development. All sanitary facilities should be connected to commercial sewers. The shrink-swell potential is a limitation for dwellings and small commercial buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent structural damage. Some land shaping generally is needed, or the building should be designed to fit the natural slope. Roads and streets generally are already available.

This Knox-Urban land complex is not assigned to a capability subclass.

62B—Macksburg-Urban land complex, 2 to 5 percent slopes. This complex consists of deep, gently sloping, somewhat poorly drained Macksburg soil and Urban land on wide, convex ridges. Individual areas are irregular in shape and range from 40 to 100 acres. This complex is about 60 percent Macksburg soil and 35 percent Urban land. The Macksburg soil and Urban land are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Macksburg soil has a surface layer of black, friable silt loam about 10 inches thick. The subsurface layer is black, friable silty clay loam about 6 inches thick. The subsoil is about 38 inches thick. The upper part is dark grayish brown, mottled, firm silty clay loam, and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, firm silty clay loam. In places the substratum is silty clay.

The Urban land part of this complex is covered by streets, driveways, parking lots, buildings, and other structures. These structures obscure or alter the soil so that identification of the soil series is not feasible.

Included with this Macksburg soil and Urban land in mapping are small areas of moderately well drained Sharpsburg soils and well drained Sibley soils. These soils are on ridgetops adjacent to Macksburg soil. The included soils make up about 5 percent of the map unit.

Permeability is moderate in this Macksburg soil, and surface runoff is medium. Natural fertility is high, and organic matter content is moderate. The available water capacity is high. A seasonal high water table is at a depth of 2 to 4 feet. The shrink-swell potential is high in the subsoil.

The Macksburg soil is suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens and to some recreational uses. It is limited for use as picnic areas and playgrounds because of wetness. Wetness can be overcome by grading to improve surface drainage, by constructing diversion terraces to intercept water from adjacent areas, and by installing tile drainage to improve the internal drainage of the soil.

The Macksburg soil is suited to building site development. All sanitary facilities should be connected to commercial sewers. The shrink-swell potential and frost action are limitations for dwellings and small commercial buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent structural damage. Drainage tile installed at the base of the sand and gravel helps to prevent damage caused by wetness. Roads and streets generally are already available.

This Macksburg-Urban land complex is not assigned to a capability subclass.

63C—Higginsville-Urban land complex, 5 to 9 percent slopes. This complex consists of moderately sloping, somewhat poorly drained Higginsville soil and Urban land on side slopes. Individual areas are irregular in shape and range from 25 to 100 acres. This complex

is about 60 percent Higginsville soil and 35 percent Urban land. The Higginsville soil and Urban land are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Higginsville soil has a surface layer of very dark brown, friable silt loam about 7 inches thick. The subsurface layer is very dark brown, friable silt loam about 5 inches thick. The subsoil is about 37 inches thick. The upper part is very dark grayish brown, friable silty clay loam; the middle part is dark brown and brown, mottled, firm silty clay loam; and the lower part is grayish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is grayish brown, mottled, friable silty clay loam. In places the subsoil has more clay.

The Urban land part of this complex is covered by streets, driveways, parking lots, buildings, and other structures. These structures obscure or alter the soils so that identification of the soil series is not feasible.

Included with this Higginsville soil and Urban land in mapping are small areas of Greenton and Sibley soils. Greenton soils have more clay in the subsoil than Higginsville soil, and they are on side slopes at a lower elevation than Higginsville soil. Sibley soils are well drained and are upslope from Higginsville soil. The included soils make up about 5 percent of the map unit.

Permeability is moderate in this Higginsville soil, and surface runoff is rapid. Natural fertility is high, and organic matter content is moderate. The available water capacity is high. A seasonal high water table is at a depth of 1.5 to 3 feet. The shrink-swell potential is moderate in the subsoil.

The Higginsville soil is well suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens and to some recreational uses. It is limited for picnic areas because of wetness; for playgrounds because of slope; and for paths and trails because it erodes easily. Areas to be used as playgrounds should be leveled to modify the slope. Constructing terraces and installing tile drainage will help to control wetness. Placing paths and trails on the contour helps to prevent erosion.

The Higginsville soil is suitable for building site development. All sanitary facilities should be connected to commercial sewers. The shrink-swell potential and frost action are limitations for dwellings and small commercial buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent structural damage. The installation of tile drainage at the base of the sand and gravel can help to prevent damage caused by wetness. Roads and streets generally are already available.

This Higginsville-Urban land complex is not assigned to a capability subclass.

64C—Greenton-Urban land complex, 5 to 9 percent slopes. This complex consists of deep, moderately sloping, somewhat poorly drained Greenton soil and Urban land on side slopes. Areas are irregular in shape and range from 25 to 75 acres. This complex is about 65 percent Greenton soil and 35 percent Urban land. The Greenton soil and Urban land are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Greenton soil has a surface layer of very dark brown, friable silty clay loam about 5 inches thick. The subsurface layer is very dark brown, friable silty clay loam about 11 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is very dark grayish brown and dark grayish brown, mottled, firm silty clay loam; the middle part is dark grayish brown, firm silty clay; and the lower part is mixed dark grayish brown and grayish brown, firm silty clay. In places the subsoil has less clay.

The Urban land part of this complex is covered by streets, driveways, parking lots, buildings, and other structures. These structures obscure or alter the soils so that identification of the soil series is not feasible.

Included with this Greenton soil and Urban land in mapping are small areas of Sampsel and Sharpsburg soils. Sampsel soils are poorly drained. They are at the heads of drainageways and on side slopes at a lower elevation than Greenton soil. Sharpsburg soils have less clay in the subsoil and are at a higher elevation than Greenton soil. The included soils make up about 5 percent of the map unit.

Permeability is slow in this Greenton soil, and surface runoff is rapid. Natural fertility is high, and organic matter content is moderate. The available water capacity is high. A seasonal high water table is at a depth of 1 foot to 3 feet. The shrink-swell potential is high in the subsoil.

The Greenton soil is well suited to lawn grasses, shade and ornamental trees, shrubs, vines, and gardens and to some recreational uses. Wetness and slow permeability are limitations for picnic areas and playgrounds. Areas should be leveled for those recreational uses that can be adapted to the limited size and shape of the open spaces. In addition, surface water should be diverted away from these areas.

The Greenton soil is suited to building site development. All sanitary facilities should be connected to commercial sewers. The shrink-swell potential and frost action are limitations for dwellings and small commercial buildings. Concrete for footings, foundations, and basement walls should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to help prevent structural damage. Drainage tile installed at the base of the sand and gravel helps to prevent damage caused by wetness. Roads and streets generally are already available.

This Greenton-Urban land complex is not assigned to a capability subclass.

65F—Snead-Urban land complex, 9 to 30 percent slopes. This complex consists of moderately deep, strongly sloping to steep, moderately well drained Snead soil and Urban land on upland side slopes. Areas are irregular in shape and range from 50 to 700 acres. This complex is about 70 percent Snead soil and 25 percent Urban land. The Snead soil and Urban land are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Snead soil has a surface layer of black, friable flaggy silty clay loam about 7 inches thick. The subsurface layer is very dark gray, firm flaggy silty clay loam about 5 inches thick. The subsoil is about 19 inches thick. The upper part is dark grayish brown, firm silty clay, and the lower part is olive gray, mottled, firm clay. The substratum to a depth of about 40 inches is olive, firm silty clay.

The Urban land part of this complex is covered by streets, driveways, buildings, and other structures. These structures obscure or alter the soil so that identification of the soil series is not feasible.

Included with this Snead soil and Urban land in mapping are small areas of Greenton and Oska soils and Rock outcrop. Greenton soils are deep. They are on side slopes and are at a higher elevation than Snead soil. Oska soils are well drained and have a reddish subsoil. They are in narrow bands and are also in a higher position than Snead soil. A few narrow limestone Rock outcrops are in areas directly above the Snead soil. The included soils make up about 5 to 10 percent of the map unit.

Permeability is slow in this Snead soil, and surface runoff is rapid. Natural fertility is low, and organic matter content is moderate. The available water capacity is low. A seasonal high water table is at a depth of 2 to 3 feet. The shrink-swell potential is high in the subsoil.

The Snead soil is suited to lawn grasses, shade and ornamental trees, and shrubs. Areas in parks should be left in the natural state. Droughtiness is a limitation. Native warm-season grasses are best suited to this soil. Young trees and shrubs need watering during dry periods. This complex generally is not suited to use for picnic areas and playgrounds because of slope and depth to bedrock. Paths and trails would need to be placed on the contour and large stones removed.

The Snead soil generally is unsuited to building site development because of the high shrink-swell potential, stones in the soil, and depth to bedrock.

This Snead-Urban land complex is not assigned to a capability subclass.

68C—Urban land, upland, 5 to 9 percent slopes. This map unit consists of moderately sloping areas where more than 85 percent of the surface is covered by asphalt, concrete, buildings, or other impervious material. Examples are parking lots, shopping and business centers, railroad yards, and industrial areas. These Urban land areas are mostly in the northwestern part of the survey area, but small tracts occur throughout the western part. The largest area is the central business district of Kansas City. Smaller areas include the industrial parks and shopping malls in the city. These areas are on upland landscapes. Most of them have been extensively reshaped by cutting and filling to lessen the slope or to produce different levels. Areas range from about 60 acres to 900 acres.

The composition of the soil material in the open areas is variable. Vegetation is mainly ornamental trees, shrubs, and lawn grasses.

Depth of the cuts and fills on areas of this map unit range from less than 3 feet to more than 20 feet on the more sloping soils. Identification of the soil is impractical because of lack of accessibility and the extreme variability of the soils. Onsite investigation is needed before changes are made in kind or intensity of use.

This Urban land is not assigned to a capability subclass.

68D—Urban land, upland, 9 to 14 percent slopes. This map unit consists of strongly sloping areas where more than 85 percent of the surface is covered by asphalt, concrete, buildings, or other impervious material. Examples are parking lots, shopping and business centers, and industrial areas. These Urban land areas are in the central business district of Kansas City. They are on the bluffs adjacent to the Missouri River flood plain. Most of these areas have been extensively reshaped by cutting and filling to produce several different elevations or levels. Areas range from about 80 acres to more than 300 acres.

The composition of the soil material in the areas that are capable of supporting vegetation is variable. Vegetation is mainly ornamental trees, shrubs, and lawn grasses.

Depth of the cuts and fills on areas of this map unit range from less than 10 feet to more than 20 feet on the more sloping soils. Identification of the soils is impractical because of lack of accessibility and the extreme variability of the soils. Onsite investigation is needed on all areas before changes are made in kind or intensity of use.

This Urban land is not assigned to a capability subclass.

69A—Urban land, bottom land, 0 to 3 percent slopes. This map unit consists of areas where more than 85 percent of the surface is covered by concrete, asphalt, buildings, or other impervious material.

Figure 16.—An area on the Missouri River flood plain. Wheat growing on Parkville silty clay is in the foreground, and Urban land, bottom land, 0 to 3 percent slopes, is in the background. Parkville soils are suited to winter wheat.

Examples are industrial areas, parking lots, shopping and business centers, and railroad yards. These areas are on the Missouri River flood plain (fig. 16) or on tributaries close to the Missouri River flood plain. Areas adjacent to the tributary streams have been built up above normal flood levels; however, these areas are subject to local flooding for short periods and during extremely large floods some areas could be covered for longer periods. Areas on the Missouri River flood plain are protected by levees, but these areas would be flooded if a levee should break. Areas range from about 100 to 600 acres.

The composition of the soil material in the open areas is variable. Vegetation is mainly ornamental trees, shrubs, and lawn grasses.

Fill has not been added to the areas at higher elevations in this map unit, but it ranges to a depth of 10 feet or more on areas at lower elevations. Identification of the soil is impractical because of lack of accessibility and the extreme variability of the soils. Onsite investigation is needed on all areas before changes are made in kind or intensity of use.

This Urban land has not been assigned a capability subclass.

73—Leta silty clay. This deep, nearly level, somewhat poorly drained soil is on the Missouri River flood plain. This soil is protected by levees, but it is still subject to occasional flooding. Individual areas are long and narrow or oval and range from 20 to 400 acres.

Typically, the surface layer is very dark gray, firm silty clay about 6 inches thick. The subsurface layer is very dark gray, very firm silty clay about 9 inches thick. The subsoil is dark grayish brown, very firm silty clay about 8 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, mottled, very friable very fine sandy loam. In places the clayey upper part of the profile is less than 20 inches thick.

Included with this soil in mapping are small areas of Gilliam and Haynie soils. Neither of these soils have silty clay in the upper layers, and both soils are at slightly higher elevations than Leta soils. The included soils make up less than 5 percent of the map unit.

Permeability is slow in the upper part of this Leta soil and moderate in the lower part. Surface runoff is slow. Reaction ranges from neutral to moderately alkaline. Natural fertility is high, and organic matter content is moderate. The available water capacity is high. A seasonal high water table is at a depth of 1 foot to 3 feet. The surface layer is firm and difficult to till. It has a narrow moisture range for good tillage operations and becomes cloddy if tilled when wet. The shrink-swell potential is high in the clayey upper part of the profile and low in the substratum.

Most areas of this soil are used for cultivated crops. This soil is well suited to soybeans and grain sorghums but is less well suited to corn and winter wheat. In places surface runoff is very slow and the surface is covered with water after hard rains or as a result of runoff from adjacent areas. Land grading and the use of shallow surface drainage and open ditches help to remove excess surface water. Returning crop residue or the regular addition of other organic material helps to increase fertility, reduce crusting, and improve water infiltration.

This soil is suited to trees, but very little acreage is in woodland. Restricted use of equipment and seedling mortality are concerns in management. Equipment operations should be timed for periods when the soil is dry or frozen. Ridging the soil and planting on the ridges help to increase the chances of seedling survival.

This soil generally is unsuited to building site development and onsite waste disposal because of the hazard of flooding and wetness. Previous flooding history should be considered in the design of any building site development and placement of sanitary facilities.

This Leta soil is in capability subclass IIw.

82—Parkville silty clay. This deep, nearly level, somewhat poorly drained soil is on the Missouri River flood plain. This soil is protected by levees, but it is still subject to occasional flooding. Individual areas are irregular in shape and range from 10 to 150 acres.

Typically, the surface layer is black, very firm silty clay about 7 inches thick. The subsurface layer is very dark gray, very firm silty clay about 10 inches thick. The substratum to a depth of 60 inches is grayish brown, mottled, very friable very fine sandy loam in the upper part and grayish brown stratified fine sand, loamy fine sand, and silt loam in the lower part. In places the clayey upper part of the profile is less than 10 inches thick. In other places the clayey upper part is more than 20 inches thick.

Included with this soil in mapping are small areas of Gilliam and Haynie soils. Gilliam soils do not have a clayey surface layer. They are at a slightly higher elevation than Parkville soil. Haynie soils are moderately well drained and do not have a clayey surface layer. They are at a higher elevation. The included soils make up 10 to 15 percent of the map unit.

Permeability is slow in the clayey upper part of this Parkville soil and moderate in the loamy lower part. Surface runoff is slow. Reaction ranges from neutral to moderately alkaline. Natural fertility is medium, and organic matter content is moderate. The available water capacity is moderate. A seasonal high water table is at a depth of 1 foot to 2 feet. The surface layer is very firm and difficult to till. It has a narrow moisture range for tillage operations and becomes cloddy if tilled when wet.

Most areas of this soil are used for cultivated crops. This soil is well suited to soybeans and grain sorghums but is less well suited to corn and winter wheat. Fieldwork is delayed because the soil is slow to warm up in the spring and slow to dry after wet periods. If this soil is used for cultivated crops, wetness is a major concern. Land grading and the use of shallow surface drains and open ditches help to remove excess water. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is suited to trees, but very little acreage is in woodland. Restricted use of equipment, seedling mortality, and plant competition are concerns in management. Equipment operations should be timed for periods when the soil is dry or frozen. Ridging the soil and planting on the ridges help to increase the chances of seedling survival. Plant competition for seedlings can be reduced by careful and thorough site preparation, including spraying or cutting. Release treatments may be necessary to ensure development.

This soil generally is unsuited to building site development and onsite waste disposal because of the hazard of flooding and wetness. Previous flooding history should be considered in the design of any building site development and placement of sanitary facilities.

This Parkville soil is in capability subclass IIw.

83—Haynie silt loam. This deep, nearly level, moderately well drained soil is on the Missouri River flood plains. This soil is protected by levees, but it is still subject to occasional flooding. Individual areas range from irregularly shaped areas of 4 acres to broad areas of 300 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The substratum to a depth of 60 inches is stratified dark grayish brown and brown, friable silt loam and very fine sandy loam in the upper part and dark grayish brown, very friable silt loam in the lower part. In places the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of somewhat poorly drained Leta, Gilliam, and Parkville soils. These soils have more clay than Haynie soils and are at slightly lower elevations. The included soils make up about 10 to 15 percent of the map unit.

Permeability is moderate in this Haynie soil, and surface runoff is slow. Reaction ranges from neutral to moderately alkaline. Natural fertility is high, and available water capacity is very high. Organic matter content is moderately low. The surface layer is friable and easily tilled through a wide range in moisture content. The shrink-swell potential is low.

Most areas of this soil are used for cultivated crops. A few areas are used for hay. This soil is suited to corn, soybeans, small grains, and grasses and legumes for hay. Returning crop residue or the regular addition of other organic material helps to improve fertility and

available water capacity, reduce crusting, and increase water infiltration.

This soil is suited to alfalfa and smooth bromegrass. Fertilization is needed. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter to help keep the stand in good condition.

This soil is suited to trees, but very little acreage is in woodland. Plant competition is a concern in management. Competition for seedlings can be reduced by careful and thorough site preparation, including spraying or cutting. Release treatments may be necessary to ensure development.

This soil generally is unsuited to building site development and onsite waste disposal because of the hazard of flooding. Previous flooding history should be considered in the design of any building site development and placement of sanitary facilities.

This Haynie soil is in capability class I.

87—Modale silt loam. This deep, nearly level, somewhat poorly drained soil is on the Missouri River flood plain. This soil is protected by levees, but it is still subject to occasional flooding. Individual areas are irregular in shape and range from about 25 to 300 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The upper layer of the substratum is dark grayish brown, very friable very fine sandy loam; the next layer is grayish brown, mottled, very friable very fine sandy loam; the next layer is mottled dark gray and grayish brown, very firm silty clay; and the lower layer to a depth of 60 inches or more is dark grayish brown, very firm silty clay.

Included with this soil in mapping are small areas of Gilliam, Haynie, and Leta soils. Gilliam and Haynie soils do not have thick clayey layers in the substratum. They are at slightly higher elevations than Modale soil. Leta soils are clayey in the upper part of the profile and are at a slightly lower elevation. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in the upper part of this Modale soil and slow in the lower part. Surface runoff is slow. Reaction is neutral or mildly alkaline in the surface layer and mildly alkaline or moderately alkaline in the substratum. Natural fertility is high, and organic matter content is moderately low. The available water capacity is moderate. A seasonal high water table is at a depth of 1 foot to 3 feet. The surface layer is friable and easily tilled through a moderately wide moisture range. The shrink-swell potential is moderate in the upper part of the profile and high in the lower part.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghums, and winter wheat. Land grading and the use of shallow surface drainage and open ditches help to remove excess water. Returning crop residue or the regular addition of other organic material helps to improve fertility and increase water infiltration.

This soil generally is unsuited to building site development and onsite waste disposal because of the hazard of flooding. Previous flooding history should be considered in the design of any building site development and placement of sanitary facilities.

This Modale soil is in capability class I.

88—Gilliam silty clay loam. This deep, nearly level, somewhat poorly drained soil is on the Missouri River flood plains. This soil is protected by levees, but it is still subject to occasional flooding. Individual areas are irregular in shape and range from 25 to 200 acres.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. The subsurface layer is about 8 inches thick. The upper part is very dark grayish brown, friable silty clay loam, and the lower part is grayish brown, firm silty clay loam. The substratum to a depth of about 60 inches is dark grayish brown, friable silty clay loam in the upper part; very dark gray, firm silty clay loam in the middle part; and stratified, very dark grayish brown, friable silt loam and dark grayish brown, friable silty clay loam in the lower part.

Included with this soil in mapping are small areas of Haynie, Leta, and Parkville soils. Haynie soils are moderately well drained and are at a slightly higher elevation than Gilliam soils. Leta and Parkville soils have more clay in the upper part of the profile and are at slightly lower elevations. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderate in this Gilliam soil, and surface runoff is slow. Reaction is mildly alkaline or moderately alkaline. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. A seasonal high water table is at a depth of 1.5 to 3 feet. The surface layer is friable and easily tilled through a moderately wide range in moisture content. It tends to become crusty or to puddle, however, after hard rains. The shrink-swell potential is moderate.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, soybeans, grain sorghums, and winter wheat. Wetness is a concern during wet periods. Land grading and the use of shallow surface drains and open ditches help to remove excess water. Returning crop residue or the addition of other organic material increases fertility, reduces crusting, and improves water infiltration.

This soil is suited to trees, but very little acreage is in woodland. There are no management problems.

This soil generally is unsuited to building site development and onsite waste disposal because of the hazard of flooding. Previous flooding history should be considered in the design of any building site development and placement of sanitary facilities.

This Gilliam soil is in capability subclass IIw.

89—Sarpy fine sand. This deep, nearly level, excessively drained soil is on the Missouri River flood plain. This soil is protected by levees, but it is still subject to occasional flooding. Individual areas are irregular in shape and range from about 10 to 90 acres.

Typically, the surface layer is very dark brown, loose fine sand about 6 inches thick. The substratum to a depth of about 60 inches is grayish brown, loose fine sand.

Included with this soil in mapping are small areas of Haynie soils. Haynie soils are not so sandy as Sarpy soils, and they are at a slightly lower elevation. The included soils make up less than 5 percent of the map unit.

Permeability is very rapid in this Sarpy soil, and surface runoff is slow. Reaction ranges from neutral to moderately alkaline. Natural fertility is low, and organic matter content is very low. The available water capacity is low. The surface layer is loose and easily tilled through a wide range in moisture conditions. The shrink-swell potential is low.

Most areas of this soil are used for alfalfa. An occasional crop of soybeans or wheat is grown when the alfalfa is reestablished. This soil is not well suited to cultivated crops because supplemental irrigation would be needed to make the soil productive. This soil is suited to alfalfa. Fertilization is needed. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter to help keep the stand in good condition.

This soil is suited to trees, but very little acreage is in woodland. Seedling mortality is a concern of management. Planting special stock of larger size than usual or using container-grown stock may be necessary to achieve a better rate of survival.

This soil generally is unsuited to building site development and onsite waste disposal because of the hazard of flooding. Previous flooding history should be considered in the design of any building site development and placement of sanitary facilities.

This Sarpy soil is in capability subclass IVs.

90—Wabash silty clay. This deep, nearly level, very poorly drained soil is on the Missouri River flood plain and its tributaries. This soil is protected by levees in the Missouri River bottom lands, but it is still subject to occasional flooding. Flooding occurs occasionally in the tributary stream bottoms. Individual areas are long and moderately wide and range from about 125 to 600 acres.

Typically, the surface layer is black, firm silty clay about 7 inches thick. The subsurface layer is black, very firm silty clay about 22 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is very dark gray, very firm silty clay; the middle part is black, very firm and dark gray, firm silty clay; and the lower part is very dark gray, very firm silty clay. In places the subsoil has less clay.

Included with this soil in mapping are small areas of Kennebec soils. Kennebec soils are moderately well drained. They have less clay and are closer to the streams than Wabash soil. The included soils make up less than 5 percent of the map unit.

Permeability is very slow in this Wabash soil, and surface runoff is very slow. Reaction ranges from medium acid to neutral in the upper part of the profile and from slightly acid to mildly alkaline in the lower part. Natural fertility is medium, and organic matter content is moderate. The available water capacity is moderate. A seasonal high water table ranges from near the surface to a depth of 1 foot. The surface layer is firm and difficult to till. It has a very narrow moisture range for good tillage operations and tends to become cloddy and compacted if tilled when wet.

Most areas of this soil are used for cultivated crops. This soil is well suited to soybeans and moderately well suited to corn, grain sorghums, and wheat. Wetness is a major concern if the soil is used for cultivated crops. This soil is slow to warm up in spring and slow to dry out after rains. Land grading and the use of shallow surface drainage and open ditches help to remove excess surface water. Returning crop residue or the regular addition of other organic material helps to increase fertility, reduce compaction, and improve water infiltration.

This soil is suited to trees, but very little acreage is in woodland. Restricted use of equipment, seedling mortality, windthrow, and plant competition are concerns in management. Equipment operations should be timed for periods when the soil is dry or frozen. Ridging the soil and planting on the ridges help to increase the chances of seedling survival. Lighter, less intensive, but more frequent thinnings to reduce the stand density may be needed to minimize the damage from windthrow. Plant competition for seedlings can be reduced by careful and thorough site preparation, including spraying or cutting. Release treatments may be necessary to ensure development.

This soil generally is unsuited to building site development and onsite waste disposal because of the hazard of flooding and wetness. Previous flooding history should be considered in the design of any building site development and placement of sanitary facilities.

This Wabash soil is in capability subclass IIIw.

91A—Napier silt loam, 0 to 3 percent slopes. This deep, very gently sloping, well drained soil is on toe slopes above the flood plain of the Missouri River tributaries. This soil is subject to runoff from adjacent upland areas. Individual areas generally are long and narrow and range from about 10 to 50 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 5 inches thick. The subsurface layer is black, friable silt loam about 17 inches thick. The subsoil is dark brown, friable silt loam about 26 inches

thick. The substratum to a depth of 60 inches is brown, friable silt loam.

Included with this soil in mapping are small areas of Kennebec and Wiota soils. Kennebec soils are moderately well drained and are in a lower position on the flood plain than Napier soil. Wiota soils have thinner, dark soil layers in the upper part of the profile and more clay in the subsoil than Napier soil. They are on terraces at a slightly lower elevation. The included soils make up about 5 percent of the map unit.

Permeability is moderate in this Napier soil, and surface runoff is medium. Reaction is slightly acid or neutral. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. The surface layer is friable and easily tilled through a moderately wide range in moisture conditions. It tends to crust or puddle, however, after hard rains. The shrink-swell potential is low.

Most areas of this soil are used for cultivated crops, pasture, and hay. This soil is well suited to corn, soybeans, winter wheat, and grain sorghums. Diversion terraces can be constructed to keep the water from adjacent uplands from flowing across this soil. Returning crop residue or the regular addition of other organic material helps to increase fertility, reduce crusting, and improve water infiltration.

This soil is well suited to alfalfa, smooth bromegrass, and most other grasses and legumes. A high level of fertility is needed for alfalfa. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices should be used. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to building site development and onsite waste disposal. Septic tanks should function adequately if they are properly designed and installed. Diversion terraces should be constructed to divert runoff from adjacent uplands. The bottoms of sewage lagoons need to be sealed with slowly permeable material to prevent seepage. There are only slight limitations for dwellings and small commercial buildings. Local roads and streets have limitations because of low strength and frost action. Grading the roads to shed water, installing adequate side ditches and culverts, and adding crushed rock or other suitable base material help to prevent damage caused by frost action and low strength.

This Napier soil is in capability class I.

92—Cotter silt loam. This deep, nearly level, well drained soil is on the Missouri River flood plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 50 to 100 acres.

Typically, the surface layer is black, friable silt loam about 7 inches thick. The subsurface layer is black, friable silty clay loam about 6 inches thick. The subsoil is about 35 inches thick. The upper part is black, friable silty clay loam; the middle part is dark brown, firm silty clay loam; and the lower part is brown, friable silt loam. The substratum to a depth of about 60 inches is brown and grayish brown, friable silt loam.

Included with this soil in mapping are small areas of Bremer, Leta, and Modale soils. All of these soils are at lower elevations than Cotter soil. Bremer soils are poorly drained, Leta soils have a clayey surface layer, and Modale soils have more clay in the substratum than Cotter soil. The included soils make up about 10 percent of the map unit.

Permeability is moderate in this Cotter soil, and surface runoff is slow. Reaction ranges from mildly alkaline to strongly acid. Natural fertility is high, and organic matter content is moderate. The available water capacity is very high. The surface layer is friable and easily tilled through a wide range of moisture conditions. It does, however, have a tendency to crust or puddle after hard rains. The shrink-swell potential is moderate in the subsoil.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, soybeans, small grains, and grasses and legumes for pasture and hay. Returning crop residue or the regular addition of other organic material helps to improve fertility, reduce crusting, and increase water infiltration.

This soil is well suited to alfalfa, smooth bromegrass, and other grasses and legumes. A high level of fertility is needed for alfalfa. Cuttings should be made by early bloom stage, and plants should have at least 6 inches of growth before winter. Good pasture management practices should be used. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture and soil in good condition.

This soil is suited to trees, but very little acreage is in woodland. Plant competition is a concern for seedlings. Thorough site preparation including spraying or cutting can reduce plant competition. Release treatments may be necessary to ensure development.

This soil is suitable for building site development and onsite waste disposal if dwellings are constructed on raised, well compacted fill material or are placed above the known flood level. Septic tanks function adequately if they are properly designed and installed. The bottoms of sewage lagoons need to be sealed with slowly permeable material to prevent seepage. The shrink-swell potential is a limitation for dwellings and small commercial buildings. Concrete for footings, foundations, and basements should be adequately reinforced with steel and a backfill of sand and gravel placed around the foundation and basement walls to prevent damage caused by shrinking and swelling of the soil. Local roads and streets have limitations because of low strength and frost action. Grading the roads to shed water, installing

adequate side ditches and culverts, and adding crushed rock or other suitable material help to prevent damage caused by frost action and low strength.

This Cotter soil is in capability class I.

100C—Urban land-Harvester complex, 2 to 9 percent slopes. This complex consists of Urban land and intermingled areas of deep, moderately sloping, well drained Harvester soil. It is on ridgetops and side slopes on uplands. Individual areas are irregular in shape and range from about 15 to 600 acres. This complex is about 65 percent Urban land and 30 percent Harvester soil. The Urban land and Harvester soil are so intermingled or intricately mixed that it is not practical to separate them in mapping.

The Urban land part of this complex is covered by streets, parking lots, buildings, and other structures. These structures so obscure or alter the soils that identification of the series is not feasible.

Typically, the surface layer of the Harvester soil is very dark grayish brown silt loam about 6 inches thick. The next layers to a depth of about 22 inches are multicolored, firm silty clay loam fill material that contains pieces of concrete, bricks, glass, and other manmade material. Below the reworked fill material to a depth of about 60 inches is a buried soil. It is brown, firm silty clay loam in the upper part and dark yellowish brown, firm silty clay loam in the lower part. In places the fill material is more than 40 inches thick. In other places the surface layer is silty clay loam, or the fill material is mostly pieces of concrete and brick from buildings that have been razed. In some places the slopes are more than 9 percent.

Included with this Urban land and Harvester soil in mapping are small areas of Knox and Sibley soils. These soils are in parks, playgrounds, and cemeteries and in a few open areas between buildings. They are not covered by fill material. The included soils make up about 5 percent of the map unit.

Because Urban land is impervious to water, surface runoff is rapid in this map unit. Permeability is moderately slow in the Harvester soil. Reaction ranges from neutral to medium acid. Natural fertility is medium, and organic matter content is low. The available water capacity is moderate. The surface layer of the Harvester soil is friable.

The Harvester soil is in yards, open spaces between buildings, parks, playgrounds, gardens, and undeveloped random tracts. Some recreational uses can be adapted to the limited size and shape of the open spaces and to the slope. Permeability is a moderate limitation for camp and picnic areas. Good surface drainage is needed, and areas of heavy foot traffic need to be resurfaced with suitable material.

The Harvester soil is suitable for building site development. Proper design of structures and adequate reinforcement in footings, foundations, and basement walls are necessary to prevent damage caused by shrinking and swelling. Drainage tile placed around footings and foundations helps to overcome excessive wetness. Community sewers are the chief means for the disposal of waste. Adding crushed rock or other suitable base material helps to prevent damage caused by low strength for local roads and streets, and providing proper drainage through side ditches and culverts or tile drainage and storm sewers helps to prevent damage caused by frost action. Detailed onsite investigation is needed in areas where site preparation requires cuts of several feet.

This Urban land-Harvester complex is not assigned to a capability subclass.

102—Udifluvents, nearly level. This map unit consists of fill areas on flood plains of tributaries of the Missouri River. These areas mostly are used for commercial purposes. One area along the Missouri River was formerly used as a solid waste dump. These areas are subject to occasional flooding. Individual areas generally are longer than they are wide and range from about 10 to 700 acres.

In a typical area of Udifluvents, the soil consists of a mixture of manmade material and silty soil material about 2 to 4 feet thick. This material has been mixed by machinery.

These fluvents are used mostly for junkyards, railroad yards and sidings, concrete casting companies, and other small industries. The area that was used as a solid waste dump in the past has been flooded, and part of the waste has washed away. Silt and sand have been deposited over the remaining waste.

Udifluvents is not assigned to a capability subclass.

103—Udorthents, nearly level. This map unit consists mainly of sanitary landfills or areas that are now being constructed for sanitary landfills. These manmade soils generally are on uplands and range from about 20 to 60 acres.

In a typical area of Udorthents, the soils on the landfills consist of a mixture of silty soil material about 3 to 4 feet thick. In most places the soil contains small pieces of brick, wood, plastic, glass, or concrete.

The completed landfills generally are seeded to vegetation. The areas still in use consist of layers of combustible and noncombustible solid waste separated by layers of soil material. Layers are proportioned as 1 foot of soil material for each 2 feet of solid waste.

Completed landfills are suitable for most kinds of vegetation. They can be used as a green belt or for recreational areas, such as parks and golf courses.

Udorthents, nearly level, is not assigned to a capability subclass.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. The acreage of high quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, should encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils usually get an adequate supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not frequently flooded during the growing season. The slope ranges mainly from 0 to 5 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 141,000 acres in Jackson County, or about 26 percent of the total area, meets the soil requirements for prime farmland. Of this amount, 59,280 acres is prime farmland only if the areas are drained. More than 80,000 acres of the prime farmland is soils on ridgetops on the uplands. These soils have slopes of 2 to 5 percent. The remaining acreage is scattered areas of other soils. Most prime farmland soils are used for cultivated crops.

More than 15 percent of the prime farmland in Jackson County has been lost to industrial and urban uses (fig. 17). The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible and difficult to cultivate and usually are less productive.

Figure 17.—Sibley-Urban land complex, 2 to 5 percent slopes. About 15 percent of the prime farmland in Jackson County has been urbanized. This soil is well suited to row crops.

The map units, or soils, that make up the prime farmland in Jackson County are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each unit is shown in table 4. The location of each map unit is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units."

If a soil meets the requirements for prime farmland only in areas where it is drained, these corrective measures are shown in parentheses after the soil name in table 5. Onsite investigation is needed to determine whether a specific area of soil is adequately drained. In Jackson County, the naturally wet soils generally have been adequately drained through the application of drainage measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Diane G. Reinhardt, district conservationist, Soil Conservation Service, assisted in the preparation of this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The soils in Jackson County have good potential for sustained food production. Most of the soils are adequately drained and have high available water capacities. About 141,000 acres in Jackson County meets the requirements for prime farmland, and an additional 89,900 acres of moderately sloping soils is favorable for crop production if the soils are protected from erosion. The potential is good for increasing production on both prime farmland soils and moderately sloping soils if the latest technology is used in crop production. Such technology would include application of conservation practices and the installation of drainage systems and irrigation systems.

Reports to the Agricultural Stabilization and Conservation Service and the Missouri Crop and Livestock Reporting Service in 1978 indicated that about 120,000 acres was used for crops, pasture, or hay. Of this acreage approximately 62,000 acres was used for row crops and 15,500 acres for close grown crops. Pastureland and hayland made up about 40,000 acres. The remaining acreage was in specialty crops (fig. 18) or was idle.

Corn, soybeans, and wheat are the principal crops in Jackson County. The acreage used for soybeans has increased by 33 percent over the past decade, and the acreage used for corn has declined by 20 percent in the past 5 years. Grain sorghum and a mixture of sorghum and sudangrass are also regularly grown. The mixture of sorghum and sundangrass is used as green chop. Double cropping is a common practice. In this cropping system soybeans or grain sorghum is planted after the wheat has been harvested.

Less than 30 percent of the cropland and pastureland in Jackson County is adequately treated to meet conservation needs. Soils not being adequately treated are mostly on the uplands. Erosion on these soils is in excess of levels considered to be tolerable to sustain production over a long period. Erosion on most of the areas now used for cultivated crops can be held to

Figure 18.—Grape vineyard on Sharpsburg silt loam, 2 to 5 percent slopes.

tolerable levels if a system of conservation practices is used. The system used should be designed to fit the specific site. Some of the marginal cropland now used for row crops should be converted to pastureland and hayland. The most effective tool for predicting soil loss is the Universal Soil Loss Equation. This survey can greatly facilitate the application of such technology.

Loss of cropland to urban development and highway construction is a serious threat in Jackson County. More than 73,000 acres has been lost to urban development. Of this acreage more than 23,000 acres was prime farmland. An additional 50,000 acres has been subdivided into 3- to 10-acre plots or is used for highway construction. These soils are permanently lost to crop production. The use of this survey to help make land use decisions that will influence the future role of farming in Jackson County is discussed in the section "General Soil Map Units."

Soil erosion is a major concern on nearly all sloping areas of cropland and overgrazed pastureland in Jackson County. Soils that have slopes of more than 2 percent are susceptible to damage from erosion. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as the Greenton, McGirk, Sampsel, and Weller soils. Erosion also reduces the productivity of soils that tend to be droughty because of low available water capacity. Examples are the Mandeville and Snead soils. Second, soil erosion on farmland results in sediment entering streams, lakes, and ponds. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreational uses, and for fish and wildlife. Erosion control also prolongs the usefulness of ponds and lakes by preventing them from filling up with sediment.

In many fields seedbed preparation and tillage operations are difficult because of clayey spots where the original, friable surface soil has been eroded away. Such spots occur in the Greenton, McGirk, Sampsel, and Weller soils. Erosion control practices provide surface cover, reduce runoff, and increase infiltration. A cropping system that keeps vegetative cover or residue on the soil can hold erosion losses to amounts that will not

reduce the productive capacity of the soils. Growing grasses and legumes for pasture and hay is a very effective means of controlling erosion. If legumes, such as clover and alfalfa, are used in crop rotations, the tilth of the soil is improved and nitrogen is provided for the following crop.

Terraces can be used to reduce the length of slopes and lessen runoff and erosion. Conventional terraces are practical on uneroded upland soils that have long, smooth slopes of less than 8 percent. On the more strongly sloping areas of the Knox and Menfro soils, however, special construction and special management techniques are needed for terrace systems to be effective. Construction of grassed backslope terraces is necessary to reduce the steepness of the slope. The construction of conventional terraces on these soils would actually increase the slope and make additional erosion control practices crucial. Cropping systems that provide substantial vegetative cover are also needed to control erosion unless conservation tillage is practiced and large amounts of residue are used. Soil loss on the moderately steep Knox soils is severe if cultivated row crops are grown. Minimizing tillage on the sloping soils and leaving large amounts of crop residue on the surface help to increase infiltration and reduce the hazards of runoff and erosion. These conservation practices can be used on many of the soils in the survey area, but they are more difficult to use successfully on eroded soils that have a clayey surface layer. Special management techniques may be needed on areas of the Greenton, McGirk, Sampsel, and Weller soils where terracing exposes the clayey subsoil.

Where terraces are unsuited to soil conditions, or where the farmer does not want to use terraces as a conservation practice, other measures can be used. Contour stripcropping reduces erosion if contour strips of permanent vegetation are maintained and areas between the strips are cultivated and row crops planted on the contour. The grass or grass-legume strips are generally used for hay. "No-till" is also becoming more commonly used. This conservation practice is effective in reducing erosion on sloping soils and can be used in many places thoughout the survey area. Special management techniques are needed on severely eroded areas.

Soil drainage is a management concern on about 25 percent of the cropland and pastureland in Jackson County. Soils on uplands, such as the Greenton, Higginsville, Macksburg, Sampsel, and Weller soils, have good surface drainage but poor or somewhat poor internal drainage. This is because permeability is moderately slow or slow throughout the profile, or the underlying material is less permeable than is needed for proper drainage. These soils stay wet and cold longer in spring than better drained soils and in some places have hillside seeps that may require the installation of tile drainage. Soils on bottom lands, such as the Bremer, Colo, Wabash, and Zook soils, are naturally wet because of their positions along the small streams, slow permeability, or both slow permeability and low elevation. In addition, these soils receive surface water from adjoining uplands. Diversion terraces can be used to intercept the water from the uplands, and shallow surface drains and land shaping can help to rid the soils of surface water. Tile drainage can be installed on the Colo soils. The somewhat poorly drained Gilliam, Leta, and Parkville soils are on the Missouri River flood plain. Field ditches and land shaping generally help to improve the drainage on these soils.

Occasional flooding is a management concern on about 40 percent of the cropland and pastureland in the survey area. Gilliam, Haynie, Leta, Modale, and Parkville soils, which are on the Missouri River flood plain, are protected from flooding by levees. The soils are adequately protected unless a levee breaks or the flooding is very extensive. Most floods occur in May or June; however, a large flood in October 1973 caused extensive damage to these soils. Bremer, Colo, Kennebec, Wabash, and Zook soils are on flood plains of smaller streams that are tributary to the Missouri River. Most of these soils are not protected by levees. Flooding on the smaller streams generally takes place from November through April, but it is of shorter duration than flooding on the Missouri River. Control of flooding on some of the smaller streams in Jackson County is feasible under conservation programs now in practice. One such program is "The Small Watershed Program," enacted as public law 566.

Soil fertility is naturally lower in most of the eroded soils and shallow soils. All soils, however, require additional plant nutrients for maximum production. Most of the soils in Jackson County are naturally acid in the upper part of the rooting zone and need applications of ground limestone to raise the pH level and calcium level sufficiently for optimum growth of legumes. On all soils additions of lime and fertilizer should be based on results of soil tests, needs of the crop, and the level of production desired. The Cooperative Extension Service can help to determine the kinds and amounts of fertilizer and lime needed.

Soil tilth is an important factor in the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous. Soil tilth is discussed for each soil in the section "Detailed Soil Map Units."

Most of the uneroded upland soils used for crops in Jackson County have a dark silt loam or silty clay loam surface layer that is moderate or high in content of organic matter. Generally, the structure of silt loam soils becomes weaker with tillage and compaction, and intense rainfall causes the formation of a crust on the surface. This crust, which is hard when dry, reduces the infiltration of water and increases runoff. Regular additions of crop residue, manure, and other organic material help to improve the soil structure and tilth.

All of the eroded upland soils have higher content of clay in the surface layers, poorer tilth, slower infiltration, and more rapid runoff than the corresponding uneroded soils. Conservation practices are needed on these soils to prevent further erosion.

Fall plowing is not a desirable practice on most upland soils, although it is common in the survey area. Most areas of cropland are made up of sloping soils that are subject to damaging erosion if they are plowed in the fall. The clayey Wabash and Zook soils, however, often stay wet until late in spring. If these soils are plowed when wet, they tend to become cloddy when dry and seedbeds are difficult to prepare. Fall plowing on these soils generally results in better tilth and does not result in damaging erosion because the soils are nearly level.

Pasture and hay crops suited to the soils and climate of Jackson County include legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are legumes grown for hay. They are commonly mixed with bromegrass, orchardgrass, or timothy for hay and pasture. Warm-season grasses include big bluestem, little bluestem, indiangrass, and switchgrass. These grasses produce well during the hot summer months. Management techniques for establishing and grazing these grasses differ from those used for cool-season grasses. Alfalfa is best suited to deep, moderately well drained or well drained soils, such as Cotter, Haynie, Kennebec, Knox, Menfro, Napier, Polo, Sharpsburg, Sibley, and Wiota soils. Other legumes and grasses grow well on most of the upland soils in the survey area. Plants that can tolerate wetness should be selected for Bremer, Colo, Sampsel, Wabash, and Zook soils. Overgrazing and gully erosion are major management concerns on most areas used for pastureland. Grazing should be controlled if plants are to survive and provide maximum production. Maintaining the grasses at proper height helps to reduce runoff and gully erosion.

Irrigation provides for increased yields by supplying supplemental water during critical periods of crop growth. Only the center-pivot system of irrigation is used in Jackson County. Double-cropping is a possibility on irrigated soils. Soybeans, for example, can be planted directly into wheat stubble and enough water supplied by irrigating to ensure germination and plant growth.

Soil and water conservation needs on upland soils should be considered, however, when weighing the relative costs and benefits of an irrigation system. Following periods of irrigation, the saturated topsoil is extremely vulnerable to erosion if intense rainfall occurs. Such accelerated erosion can drastically reduce the natural fertility and cause rapid sedimentation of any bodies of water downstream. Because most irrigation systems are supplied by reservoirs which are in the irrigated watershed, such sedimentation reduces the irrigation capacity. As there are no wells in Jackson County that can produce enough water for irrigation purposes, protection of the topsoil from erosion is doubly important. Maintenance of terraces is also a management concern on irrigated soils. If ruts are formed where the wheels of the system pass over the saturated terrace berm, the effectiveness of the terraces is reduced.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and

limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey (*15*). These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production. There are no class V or class VIII soils in Jackson County.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

In class I there are no subclasses because the soils of this class have few limitations.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Woodland Management and Productivity

James L. Robinson, Soil Conservation Service, assisted in the preparation of this section.

A significant number of soils in Jackson County developed under prairie grasses. There were very few trees. In 1972, woodland made up 22,600 acres, or 6 percent of the total land area (*16*). Forest cover has decreased in recent years because of changing land uses, mainly urban development.

Most of the timber in the survey area is in the Knox-Sibley-Urban land association and the Snead-Menfro-Oska association. White oak, black oak, northern red oak, hickory, walnut, and white ash are common species. Most of the trees in these associations are on the Snead soils. The better quality stands generally are on the Knox and Menfro soils. These soils have good potential for commercial production of white oak and black walnut. The lower quality stands include post oak, elm, and hickory. Most of the soils in woodland need to be improved to increase their production potential.

Small fringe areas of timber grow along the streams in the Kennebec-Colo-Bremer association. Sycamore, silver maple, hackberry, green ash, cottonwood, and black willow are common species. These trees may grow in pure stands or in association with other bottom land hardwoods. The Kennebec soils have very good potential for commercial production of black walnut.

The Haynie-Urban land-Leta association is on the Missouri River bottom lands. Trees grow in areas that are too wet to farm, are not frequently flooded, or are not protected by a levee. Cottonwood is generally the most common tree, but sycamore, green ash, silver maple, and box elder also grow on these bottom lands. These areas are highly productive timber sites and have good potential for management.

The Macksburg-Sharpsburg-Sampsel association and the Higginsville-Sibley-Sharpsburg association are in prairie and have very little timber; however, abandoned fields are often invaded by woody vegetation, such as osageorange, honeylocust, shingle oak, and black locust. These species have low potential for commercial timber production but are commonly used for firewood.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the

expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that few trees may be blown down by strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

Windbreaks and Environmental Plantings

James L. Robinson, forester, Soil Conservation Service, assisted in preparation of this section.

Many farmsteads and fields on the prairie areas throughout Jackson County are unprotected from winter winds and blowing snow. Although windbreak protection is needed throughout the county, the greatest need for well planned windbreaks is in the Macksburg-Sharpsburg-Sampsel association and the Higginsville-Sibley-Sharpsburg association.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

Edward A. Gaskins, biologist, Soil Conservation Service, assisted in the preparation of this section.

The 1980 Statewide Comprehensive Outdoor Recreation Plan (SCORP) listed 26,549 acres of recreational developments in Jackson County (*12*). Of these developments 35 percent was county owned, 25 percent was municipally owned, and 13 percent was State owned. Thirteen percent was owned by private interests and the remaining 8 percent by other interests.

Facilities of these developments include water sports areas; marinas; golf courses and swimming areas; hunting and fishing areas; campgrounds; bicycle paths and horse, hiking, and motorcycle trails; game courts; nature study areas; archery and shooting ranges; skating areas; ballfields, picnic areas, and playgrounds; horse arenas; zoos; interpretative centers and historical sites; fairgrounds; and wildlife viewing areas. A 1970 SCORP report cited a need to increase the miles of foot trails and bike paths, the number of playfields and swimming pools, and facilities for camping and fishing by 1990.

The Lake Jacomo-Fleming Park Area has more than 4,000 acres. It is the largest public recreational area in Jackson County. The James A. Reed Wildlife Area, which is owned by the State, has 2,456 acres. An additional 23 recreational areas make up more than 100 acres each. The county has 220 public recreational

areas that range from large parks to small neighborhood playgrounds.

The newly constructed Smithville Lake in Clay County, 5 miles north of Kansas City, will greatly increase the opportunities for water based recreation in Jackson County. Six public parks that will supply more than 900 campsites will be connected with the reservoir. Group camps, beaches, boat marinas, a lodge convention center, all types of water sports, and many other recreational activities will be provided. The 7,190-acre lake has 175 miles of shoreline. This area will accomodate 1,400,000 visitors annually.

The 1974 NACD Nationwide Outdoor Recreation Inventory listed 30 private and semiprivate commercial enterprises in Jackson County (*4*). These operations ranged from swimming clubs, golf courses, and riding stables to lake development properties, a gun club, campgrounds, tennis courts, and lakes for fishing. The inventory cited campgrounds and vacation farm enterprises as top priority needs. Smithdale Lake will supply these needs.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Edward A. Gaskins, biologist, Soil Conservation Service, assisted in the preparation of this section.

Jackson County is one of 13 counties that make up the West Prairie Zoogeographic Region in Missouri (*11*). Before cultivation, the primary vegetation was tall grass prairie and oak-hickory forest. Today only scattered remnants of the original prairie remain. Trees now grow mostly along the streams and watercourses. The original ecosystem has been changed by clearing the land and cultivating the soils and by commercial timber harvesting, overgrazing, and urban development. Urban pressure from the Kansas City metropolitan area will continue to cause changes in land use and wildlife habitat within the survey area.

The wildlife game species in Jackson County favor an openland agricultural type of habitat. The Kennebec-Colo-Bremer, Macksburg-Sharpsburg-Sampsel, and Haynie-Urban land-Leta associations are more than 50 percent cropland and grassland. These associations,

together with the Higginsville-Sibley-Sharpsburg, Snead-Menfro-Oska, and Knox-Sibley-Urban land associations, provide the openland habitat for wildlife in the survey area. The small blocks of timber, waterways, hedgerows, fence rows, and other areas of wooded or brushy cover supply the edge or "hard cover" that is essential for the majority of openland wildlife. At present these key habitat areas are fast disappearing in those areas of the county that are intensively cultivated and urbanized. This cover extends into the food producing areas, and its loss seriously threatens the continued existence of openland wildlife.

Quail populations are rated as good, and rabbits are rated as good to excellent in Jackson County. The dove population, which is rated fair to good, is increased by migratory flights to the area during the fall hunting season. The songbird population is rated good to excellent throughout the county.

The furbearer population is rated good in the survey area. Trapping has increased during the past years because of rising fur prices. Raccoon, opossum, coyote, muskrat, beaver, skunk, and red and gray foxes were the most trapped species during the 1976-1979 seasons.

There are no predominantly woodland associations in Jackson County. The Snead-Menfro-Oska association is 25 percent woodland, the Knox-Sibley-Urban land association is 20 percent woodland, and the other associations range from 5 to 15 percent woodland. These woodland areas provide the habitat for woodland wildlife. The deer population is rated fair to good for an urbanized county. Most of the deer inhabit the wooded bottom lands. The carrying capacity for deer has been reached in the county. Turkeys have been stocked in at least four places within the county by the Missouri Department of Conservation. They should expand into other areas of available habitat within the next few years. Populations of fox squirrels are rated good in areas where there is sufficient mast producing woodland. A small population of woodcock is resident within the county, but these birds are not hunted.

Wetland habitat is very limited in the survey area. The Kennebec-Colo-Bremer association and the Haynie-Urban land-Leta association have wetland habitat areas, but because they are also prime bottom land soils, most of these areas have been drained and are now intensively cultivated. The remaining areas of woodland are intact because of wetness. The few permanent wetlands are in the Jackass Bend Area. Large numbers of snow geese, blue geese, Canadian geese, and ducks migrate to the Reed Memorial Wildlife Area and Lake Jacomo. These heavy migratory flights attract waterfowl hunters to the river areas each year. Small numbers of wood ducks inhabit a few of the waterways of the county. Sni-A-Bar Creek provides the best habitat for wood ducks.

The rivers, streams, lakes, and ponds in Jackson County supply numerous opportunities for fishing. There are 113 miles of permanent flowing streams in the survey area (*6*). All of the rivers have problems caused by various forms of pollution. The Missouri River, which forms the northern boundary of the county for about 43 miles, is regularly fished by commercial fisherman for carp, carpsucker, buffalo, and channel and flathead catfish. Walleye, sauger, northern pike, paddlefish, crappie, and white bass are occasionally caught. Jugs, trotlines, and limblines are used noncommercially to fish for catfish, carp, and sturgeon. The Big Blue and Little Blue Rivers provide light fishing for bullhead and carp. Sni-A-Bar Creek is mostly fished for bullhead.

Impoundment fishing opportunities are numerous in the survey area. Jacomo Lake, Prairie Lee Lake, and Lee's Summit Lake have free access to fishing. The Reed Memorial Wildlife Area and Swope Park have smaller lakes that are also open to fishing. Subdivision developments, such as Lake Lotawana, Lake Tapawingo, Tarsney Lake, and Raintree Lake, permit restricted fishing.

More than 864 farm ponds and small lakes in Jackson County have been stocked with fish. Most of these water areas have been stocked with largemouth bass, channel catfish, and bluegill.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be

expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, millet, soybeans, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are bluegrass, switchgrass, orchardgrass, indiangrass, clover, alfalfa, trefoil, and crownvetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, pokeweed, foxtail, croton, and partridgepea.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, wild plum, sumac, persimmon, and sassafras. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn-olive, crabapple, Amur honeysuckle, and hazelnut.

Coniferous plants furnish winter cover, browse, and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cutgrass, cattail, rushes, sedges, and buttonbush.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Species of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, red fox, woodchuck, and mourning dove.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Species of wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this

section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor

and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome;

moderate if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than

that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*17*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll (*Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiudoll (*Arg*, meaning argillic horizon, plus *udoll*, the suborder of the Mollisols that have an udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiudolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Argiudolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*14*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*17*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Bremer Series

The Bremer series consists of deep, poorly drained soils on stream terraces. Permeability is moderately slow. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Bremer soils are similar to Sampsel soils and commonly are adjacent to Colo, Kennebec, and Zook soils. Colo, Kennebec, and Zook soils have mollic epipedons that are 36 inches or more in thickness. They do not have argillic horizons and are lower on the landscape than Bremer soils. Sampsel soils are gently sloping to moderately sloping.

Typical pedon from an area of Bremer silt loam, 1,350 feet north and 1,525 feet east of the southwest corner of sec. 2, T. 47 N., R. 30 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many very fine roots; slightly acid; abrupt smooth boundary.

A—8 to 21 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; friable; common very fine roots; slightly acid; clear smooth boundary.

Bt1—21 to 26 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; common faint clay films on faces of peds; clay flows in old root channels; few very fine roots; slightly acid; clear smooth boundary.

Bt2—26 to 30 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) and common fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; many faint very dark gray (10YR 3/1) clay films on faces of peds; few very fine roots; slightly acid; clear smooth boundary.

Bt3—30 to 44 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium prominent strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; firm; many faint very dark gray (10YR 3/1) clay films on faces of peds; few very fine roots; few black concretions; slightly acid; gradual smooth boundary.

Bt4—44 to 60 inches; mottled dark grayish brown (10YR 4/2), dark yellowish brown (10YR 4/4), very dark gray (10YR 3/1), and gray (10YR 5/1) silty clay loam; weak medium subangular blocky structure; firm; common faint clay films on faces of peds; few black stains and concretions; slightly acid.

The solum thickness ranges from 40 to 60 inches. Depth to free carbonates is more than 60 inches. The mollic epipedon is 24 to 36 inches thick.

The A horizon is black (10YR 2/1) or very dark gray (N 3/0). It is silty clay loam or silt loam. It is 14 to 24 inches thick. Reaction ranges from medium acid to neutral.

The Bt horizons in the upper part of the profile have hue of 10YR or 2.5Y, value of 3, and chroma of 1; however, value increases to 4 or 5 and chroma increases to 2 as depth increases. Mottles of high and low chroma are in the Bt horizon. Reaction is medium acid or slightly acid. The B horizons typically are silty clay loam, but some profiles have B horizons of silty clay.

The BC and C horizons have hue of 10YR through 5Y, value of 4 or 5, and chroma of 1. They typically are silty clay loam.

Colo Series

The Colo series consists of deep, poorly drained, moderately permeable soils on bottom lands. These soils formed in silty alluvium that is less than 15 percent sand. Slopes range from 0 to 2 percent.

Colo soils are similar to Zook soils and commonly are adjacent to Bremer, Kennebec, and Zook soils. Bremer soils have argillic horizons. They are on terraces and are in higher positions on the landscape than Colo soils. Kennebec soils are moderately well drained and are closer to the streams. Zook soils have more clay.

Typical pedon from an area of Colo silty clay loam, 1,340 feet east and 20 feet south of the northwest corner of sec. 21, T. 49 N., R. 29 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak very fine granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A1—6 to 15 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium granular structure; firm; common fine roots; medium acid; clear smooth boundary.

A2—15 to 23 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 3/4) mottles; moderate fine granular structure; firm; common fine roots; slightly acid; gradual smooth boundary.

Bw1—23 to 36 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 3/4) mottles; weak medium subangular blocky structure; firm; common fine roots; slightly acid; gradual smooth boundary.

Bw2—36 to 47 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium angular blocky structure; firm; shiny surfaces on faces of peds; common fine roots; neutral; gradual smooth boundary.

Cg—47 to 63 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; massive; firm; neutral.

The solum ranges from 36 to 54 inches in thickness and does not have free carbonates. Reaction ranges from neutral to medium acid in the upper part of the solum and is neutral or slightly acid in the lower part. The mollic epipedon is 36 inches or more in thickness.

The A horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. They are typically silty clay loam that is 27 to 35 percent clay, but some surface layers are silt loam. Horizons below the A horizon are silty clay loam that is 30 to 35 percent clay. Colors are similar to those

of the A horizon. Brown, yellowish brown, and grayish mottles commonly occur below a depth of 24 inches.

Cotter Series

The Cotter series consists of deep, well drained, moderately permeable soils on high bottoms or old natural levees of the Missouri River. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Cotter soils are similar to Wiota soils and commonly are adjacent to Bremer, Leta, and Modale soils. Bremer, Leta, and Modale soils are not so well drained as Cotter soils, and they are in slightly lower positions on the landscape. Wiota soils have more clay in the lower part of the solum.

Typical pedon from an area of Cotter silt loam, 2,650 feet south and 1,000 feet east of the northwest corner of sec. 35, T. 51 N., R. 31 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine and very fine granular structure; friable; many fine roots; fine pores and wormholes; medium acid; clear smooth boundary.

A—7 to 13 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium angular blocky structure parting to weak very fine granular; friable; many fine roots; medium acid; clear smooth boundary.

Bt1—13 to 24 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; very dark brown (10YR 2/2) crushed; moderate very fine subangular blocky structure; friable; common fine roots and pores; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—24 to 32 inches; dark brown (10YR 4/3) silty clay loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate fine subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt3—32 to 42 inches; dark brown (10YR 4/3) silty clay loam; weak medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

BC—42 to 48 inches; brown (10YR 5/3) silt loam; very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine faint grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

C—48 to 60 inches; brown (10YR 5/3) and grayish brown (10YR 5/2) silt loam; massive; friable; few fine roots; neutral.

The thickness of the solum ranges from 40 to 60 inches. The thickness of the mollic epipedon ranges from 24 to 36 inches.

The A horizon and the Bt1 horizon have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A horizon typically is silt loam, but the range includes silty clay loam.

The Bt2 and BC horizons have hue of 10YR, value of 4 or 5, and chroma of 3 or 4. They are silt loam or silty clay loam that is 25 to 35 percent clay. Reaction ranges from strongly acid to neutral in the B horizon.

The C horizon has hue of 10YR to 2.5Y, value of 4 to 6, and chroma of 2 to 4.

Gilliam Series

The Gilliam series consists of deep, somewhat poorly drained, moderately permeable soils on the Missouri River bottom land. These soils formed in thick deposits of silty, stratified alluvium. Slopes range from 0 to 2 percent.

Gilliam soils commonly are adjacent to Haynie, Leta, and Parkville soils. Haynie soils do not have a mollic epipedon and are at a slightly higher elevation than Gilliam soils. Leta and Parkville soils are clayey and are underlain by loamy material. They are at slightly lower elevations.

Typical pedon from an area of Gilliam silty clay loam, 600 feet south and 2,500 feet west of the northeast corner of sec. 15, T. 51 N., R. 30 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A1—7 to 11 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A2—11 to 15 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine angular blocky structure; firm; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C—15 to 22 inches; dark grayish brown (10YR 4/2) silty clay loam; appears massive but has distinct bedding planes; friable; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

Ab—22 to 26 inches; very dark gray (10YR 3/1) silty clay loam; weak fine subangular blocky structure; firm; slight effervescence; mildly alkaline; abrupt smooth boundary.

C'—26 to 60 inches; stratified dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam and silty clay loam; thin lenses of very dark gray (10YR 3/1) silty clay; appears massive but has weak or distinct bedding planes; friable; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The average clay content of the 10- to 40-inch control section is 18 to 35 percent. Reaction is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. Thin strata in the C horizon have value of 2 or 3 and chroma of 1 or 2. The C horizon is silt loam and silty clay loam that has thin strata of silty clay, fine sandy loam, or very fine sand. Mottles have hue of 7.5YR to 2.5Y, value of 4 through 6, and chroma of 2 through 6.

Greenton Series

The Greenton series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in thin loess and residuum from interbedded silty and clayey shales. Slopes range from 5 to 9 percent.

Greenton soils are similar to Macksburg soils and commonly are adjacent to Macksburg, Oska, Sampsel, and Snead soils. Macksburg soils have less clay in the B and C horizons than Greenton soils. Oska and Snead soils are moderately deep. Sampsel soils are poorly drained. Oska, Sampsel, and Snead soils are on side slopes and are at lower elevations than Greenton soils.

Typical pedon from an area of Greenton silty clay loam, 5 to 9 percent slopes, 2,300 feet north and 1,000 feet west of the southeast corner of sec. 9, T. 47 N., R. 32 W.

Ap—0 to 5 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

A—5 to 16 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

BA—16 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to moderate fine granular; friable; few fine roots; medium acid; clear smooth boundary.

Bt1—19 to 26 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine prominent strong brown (7.5YR 4/6) mottles; moderate very fine subangular blocky structure; firm; few fine roots; many faint dark brown (10YR 3/3) clay films on faces of peds; medium acid; clear smooth boundary.

2Bt2—26 to 35 inches; dark grayish brown (10YR 4/2) silty clay; many fine prominent strong brown (7.5YR 4/6) mottles; moderate fine subangular blocky structure; very firm; few fine roots; many faint clay films on faces of peds; medium acid; clear smooth boundary.

2Bt3—35 to 46 inches; dark grayish brown (10YR 4/2) silty clay; many fine distinct brown (7.5YR 4/2) and many fine prominent strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; many faint clay films on faces of peds; slightly acid; gradual smooth boundary.

2Bt4—46 to 60 inches; mixed dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) and common fine prominent strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; very firm; common faint clay films on faces of peds; slightly acid.

The thickness of the solum ranges from 40 to 60 inches, and depth to free carbonates is more than 60 inches. The mollic epipedon ranges from 10 to 20 inches in thickness and generally includes the upper part of the B horizon.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction is medium acid or slightly acid.

The Bt horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. Mottles are strong brown, yellowish brown, and reddish brown. Reaction is medium acid or slightly acid.

Harvester Series

The Harvester series consists of deep, moderately well drained soils on uplands. Permeability is moderately slow. These soils formed in 20 to 40 inches of loess fill material over truncated or buried, deep loess soils. Slopes range from 2 to 9 percent.

Harvester soils commonly are adjacent to Knox and Sibley soils in the Knox-Urban land and Sibley-Urban land complexes and to Urban land, upland. Knox and Sibley soils have not been disturbed by construction equipment and do not have concrete, bricks, and glass in the profile. Urban land, upland, is in positions similar to those of Harvester soils but is more than 85 percent covered by asphalt, concrete, buildings, and other structures.

Typical pedon of Harvester silt loam from an area of Urban land-Harvester complex, 2 to 9 percent slopes, 700 feet south and 2,100 feet east of the northwest corner of sec. 20, T. 49 N., R. 33 W.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

C1—6 to 14 inches; mixed dark yellowish brown (10YR 4/4) and brown (10YR 4/3) silty clay loam; massive; firm; common fine roots; common small pieces of concrete; slightly acid; abrupt smooth boundary.

C2—14 to 22 inches; mixed very dark grayish brown (10YR 3/2), brown (10YR 4/3), and dark yellowish brown (10YR 4/4) silty clay loam; massive; friable; few fine roots; common small pieces of concrete, brick, glass, and wood; neutral; clear smooth boundary.

Bb1—22 to 30 inches; brown (10YR 4/3) silty clay loam; moderate very fine angular blocky structure; firm; few fine roots; slightly acid; gradual smooth boundary.

Bb2—30 to 38 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate very fine angular blocky structure; firm; few fine roots; slightly acid; gradual smooth boundary.

Bb3—38 to 49 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; few faint dark brown (7.5YR 4/4) clay films on faces of peds; medium acid; gradual smooth boundary.

BCb—49 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak medium subangular blocky structure; firm; few fine roots; few faint dark brown (7.5YR 4/4) clay films on faces of some peds; medium acid.

Depth to bedrock is more than 60 inches. Reaction ranges from neutral to medium acid throughout the profile.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 through 4. It typically is silt loam, but the range includes silty clay loam.

The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 through 6. It is silt loam or silty clay loam that has clay content ranging from 18 to 35 percent. A buried A horizon is in some pedons. This horizon has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. The buried A horizon commonly is silt loam but ranges to silty clay loam. The buried B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 through 5.

Haynie Series

The Haynie series consists of deep, moderately well drained, moderately permeable soils on the Missouri River flood plain. These soils formed in silty and loamy, calcareous alluvium. Slopes range from 0 to 2 percent.

Haynie soils commonly are adjacent to Gilliam, Leta, and Parkville soils. Gilliam soils have a mollic epipedon and are somewhat poorly drained. Leta and Parkville soils have clayey surface layers more than 12 inches thick. Gilliam, Leta, and Parkville soils are at slightly lower elevations than Haynie soils.

Typical pedon from an area of Haynie silt loam, 3,300 feet east and 700 feet north of the southwest corner of sec. 12, T. 50 N., R. 32 W.

A—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; common fine roots; few fine pores and old root channels; common wormcasts; neutral; clear smooth boundary.

C1—9 to 22 inches; mixed dark grayish brown (10YR 4/2) and brown (10YR 5/3) very fine sandy loam; weak medium granular structure; very friable; weak very fine bedding planes; common fine roots; few fine pores and old root channels; common wormcasts; slight effervescence; mildly alkaline; clear smooth boundary.

C2—22 to 49 inches; dark grayish brown (10YR 4/2) silt loam; massive; very friable; few fine pores and old root channels; slight effervescence; mildly alkaline; clear smooth boundary.

C3—49 to 60 inches; dark grayish brown (10YR 4/2) silt loam; common fine faint dark brown (10YR 4/3) mottles; massive; very friable; slight effervescence; mildly alkaline.

The solum is less than 10 inches thick and has free carbonates throughout the control section. Reaction is mildly alkaline or moderately alkaline between depths of 10 to 60 inches.

The A horizon is dominantly silt loam, but the range includes very fine sandy loam.

The C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. They are typically stratified silt loam and very fine sandy loam, but some pedons have thin strata of fine sandy loam or loamy fine sand. Stains and brownish mottles commonly occur below a depth of 24 inches.

Higginsville Series

The Higginsville series consists of deep, somewhat poorly drained, moderately permeable soils on uplands. These soils formed in silty loess several feet thick. Slopes range from 5 to 9 percent.

Higginsville soils are similar to Macksburg soils and are commonly adjacent to Macksburg, Sibley, and Sharpsburg soils. Macksburg soils have a higher clay content in the Bt horizon than Higginsville soils. Sibley soils are well drained. Sharpsburg soils are moderately well drained and have more clay in the Bt horizons. Sibley and Sharpsburg soils are on ridgetops and side slopes and are in higher positions on the landscape than Higginsville soils.

Typical pedon from an area of Higginsville silt loam, 5 to 9 percent slopes, 320 feet north and 500 feet west of the southeast corner of sec. 32, T. 50 N., R. 29 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; many fine roots; medium acid; abrupt smooth boundary.

A—7 to 12 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium granular structure; friable; many fine roots; medium acid; clear smooth boundary.

BA—12 to 18 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; dark brown (10YR 3/3) crushed; weak fine subangular blocky structure; friable; common fine roots; medium acid; clear smooth boundary.

Bt1—18 to 25 inches; dark brown (10YR 4/3) silty clay loam; common fine distinct grayish brown (10YR 5/2) and common fine faint dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; common fine roots; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—25 to 35 inches; brown (10YR 4/3) silty clay loam; common fine faint grayish brown (10YR 5/2) and common fine distinct dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; many faint dark grayish brown (10YR 4/2) clay films on faces of peds; common medium black iron and manganese concretions; common medium prominent dark reddish brown (5YR 3/3) and reddish brown (5YR 4/3) mottles in lower 3 inches; medium acid; clear smooth boundary.

Bt3—35 to 49 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent yellowish red (5YR 4/6) mottles; weak medium and coarse subangular blocky structure; friable; common faint clay films on faces of peds; few black iron and manganese concretions; medium acid; gradual smooth boundary.

C—49 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent red (2.5YR 4/8) and yellowish red (5YR 4/6) mottles; massive; friable; medium acid.

The thickness of the solum ranges from 8 to 54 inches. The mollic epipedon ranges from 10 to 24 inches in thickness and includes the BA horizon.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly silt loam, but the range includes silty clay loam.

The Bt horizons have hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 or 3 in the upper part. Some pedons have coatings on faces of peds that have chroma of 1. The lower part of the Bt horizons includes value of 4 or 5 and chroma of 1 through 3. Mottles that have higher value and chroma are commonly present. The B horizon is silty clay loam that averages 32 to 35 percent clay. Reaction is strongly acid to slightly acid.

The C horizons have dominant hue of 2.5Y through 10YR, value of 4 or 5, and chroma of 1 or 2. Mottles that have hue of 10YR through 5YR, value of 3 through 5, and chroma of 3 through 8 are commonly present. The C horizon is commonly silt loam, but the range includes silty clay loam. Reaction is medium acid or slightly acid.

Kennebec Series

The Kennebec series consists of deep, moderately well drained, moderately permeable soils on bottom lands. These soils formed in silty alluvium that is less than 15 percent sand. Slopes range from 0 to 2 percent.

Kennebec soils are similar to Napier soils and commonly are adjacent to Bremer, Colo, Wiota, and Zook soils. Bremer soils are poorly drained and have an argillic horizon. They are on stream terraces and are at a higher elevation than Kennebec soils. Colo and Zook soils also are poorly drained. They have a higher clay content in the control section than Kennebec soils and are farther from the stream channel. Napier soils have a mollic epipedon less than 36 inches thick. Wiota soils have an argillic horizon and are on stream terraces at a higher elevation than Kennebec soils.

Typical pedon from an area of Kennebec silt loam, 1,200 feet west and 50 feet north of the southeast corner of sec. 28, T. 50 N., R. 31 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine roots; slightly acid; abrupt smooth boundary.

A1—9 to 19 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots and pores; neutral; clear smooth boundary.

A2—19 to 39 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; few fine roots; common fine pores; slightly acid; clear smooth boundary.

AC—39 to 56 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; common fine prominent strong brown (7.5YR 4/6) mottles; weak fine subangular blocky structure; friable; common fine pores; slightly acid; gradual smooth boundary.

C—56 to 60 inches; very dark grayish brown (10YR 3/2) silt loam, light brownish gray (10YR 6/2) dry; common fine prominent strong brown (7.5YR 4/6) mottles; massive; friable; few fine distinct dark yellowish brown (10YR 4/4) iron and manganese accumulations; common fine pores; slightly acid.

The solum and the mollic epipedon are more than 36 inches thick. Texture is silt loam or silty clay loam.

The A horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction generally is neutral or slightly acid but may be medium acid in the upper part.

The C horizons have hue of 10YR, value of 2 through 4, and chroma of 1 or 2. Reaction is neutral or slightly acid.

Knox Series

The Knox series consists of deep, well drained, moderately permeable soils on hills and bluffs bordering the Missouri River Valley and its tributaries. These soils formed in thick, silty loess. Slopes range from 5 to 30 percent.

Knox soils are similar to Menfro soils and are commonly adjacent to Sibley and Snead soils. Menfro soils have a lighter colored surface layer. Sibley soils have a mollic epipedon 24 or more inches thick. They are on broader ridgetops and less sloping side slopes than Knox soils. Snead soils are moderately deep. They are on side slopes at a lower elevation than Knox soils.

Typical pedon from an area of Knox silt loam, 5 to 9 percent slopes, 330 feet north and 260 feet west of the southeast corner of sec. 34, T. 51 N., R. 30 W.

A—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; many roots; few wormholes and wormcasts; medium acid; clear smooth boundary.

E—7 to 12 inches; brown (10YR 4/3) silt loam; weak very fine granular structure; friable; many roots; few wormholes and wormcasts; medium acid; clear smooth boundary.

Bt1—12 to 23 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate very fine subangular blocky structure; firm; few roots; many faint brown (10YR 4/3) clay films on faces of peds; grayish brown (10YR 5/2) silt coatings on faces of some peds; medium acid; clear smooth boundary.

Bt2—23 to 35 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; few roots; common faint brown (10YR 4/3) clay films on faces of some peds and in old root channels; medium acid; gradual smooth boundary.

Bt3—35 to 61 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate coarse subangular blocky structure; friable; common faint clay films on faces of some peds; medium acid; gradual smooth boundary.

C—61 to 71 inches; dark yellowish brown (10YR 4/4) silt loam; massive; friable; few thin dark yellowish brown (10YR 3/4) clay flows along vertical cleavages; neutral.

The thickness of the solum ranges from 36 to 60 inches or more. Reaction ranges from medium acid to neutral, and depth to free carbonates is more than 60 inches.

The A1 or Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. It is commonly silt loam, but the range includes silty clay loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 through 6. It is silty clay loam or silt loam that is 25 to 35 percent clay in the finest textured part.

The C horizon is silt loam that has colors similar to those of the B horizon.

Knox silty clay loam, 5 to 14 percent slopes, severely eroded, and the Knox soil in the Knox-Urban land complex, 9 to 14 percent slopes, do not have the dark surface layer that is defined for the Knox series. This difference, however, does not significantly affect the use or management of the soils.

Leta Series

The Leta series consists of deep, somewhat poorly drained soils on the Missouri River bottom lands. Permeability is slow in the upper part of the profile and moderate in the lower part. These soils formed in 20 to 40 inches of fine textured alluvium over loamy alluvium. Slopes range from 0 to 2 percent.

Leta soils are similar to Parkville soils and commonly are adjacent to Gilliam, Haynie, and Parkville soils. Gilliam soils are fine-silty and are stratified below the Ap horizon. Haynie soils are coarse-silty and have a dark surface layer less than 10 inches thick. Parkville soils have 12 to 20 inches of fine textured alluvium overlying loamy material. All of these soils are at slightly higher elevations than Leta soils.

Typical pedon from an area of Leta silty clay, 2,000 feet east and 2,500 feet north of the southwest corner of sec. 24, T. 50 N., R. 31 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak fine granular structure; firm; few fine roots; neutral; abrupt smooth boundary.

A—6 to 15 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very firm; few fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

Bw—15 to 23 inches; dark grayish brown (10YR 4/2) silty clay; weak fine angular blocky structure; very firm; few fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

2C—23 to 60 inches; dark grayish brown (10YR 4/2) very fine sandy loam; common fine faint grayish brown (10YR 5/2) and few fine prominent dark brown (7.5YR 4/4) mottles; appears massive but has weak bedding planes; very friable; violent effervescence; moderately alkaline.

The solum ranges from 20 to 38 inches in thickness. The mollic epipedon ranges from 10 to about 20 inches in thickness. Free carbonates are throughout the control section.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction is neutral or mildly alkaline.

The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. Mottles are of higher chroma. The Bw horizon is silty clay loam or silty clay that averages 35 to 48 percent clay.

The 2C horizon has hue of 10YR, value of 4 through 6, and chroma of 1 or 2. Mottles are of higher chroma. The C horizon commonly is stratified silt loam and very fine sandy loam but may have thin layers of loamy fine sand.

Macksburg Series

The Macksburg series consists of deep, somewhat poorly drained soils on uplands. Permeability is moderately slow. These soils formed in silty loess that is several feet thick. Slopes range from 2 to 5 percent.

Macksburg soils are similar to Greenton and Higginsville soils and commonly are adjacent to Greenton, Higginsville, and Sibley soils. Greenton soils have more clay in the lower part of the B horizon and the C horizon than Macksburg soils. Higginsville soils have less clay in the Bt horizon and are moderately sloping. Sibley soils are well drained and are on ridgetops at a higher elevation than Macksburg soils.

Typical pedon from an area of Macksburg silt loam, 2 to 5 percent slopes, 1,300 feet south and 650 feet west of the northeast corner of sec. 22, T. 47 N., R. 31 W.

A1—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; very dark brown (10YR 2/2) crushed; moderate fine and very fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

A2—10 to 16 inches; black (10YR 2/1) silty clay loam, gray (10YR 5/1) dry; very dark brown (10YR 2/2) crushed; weak fine subangular blocky structure parting to moderate medium granular; friable; many fine roots; medium acid; clear smooth boundary.

Bt1—16 to 23 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) organic stains on faces of peds; common fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; many fine roots; few distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—23 to 31 inches; grayish brown (10YR 5/2) silty clay loam; many fine distinct dark yellowish brown (10YR 4/4 and 4/6) mottles; moderate fine angular blocky structure; firm; many fine roots; many distinct very dark gray (10YR 3/1) clay films on faces of peds; few fine black iron and manganese concretions; strongly acid; clear smooth boundary.

Bt3—31 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine distinct dark yellowish brown (10YR 4/6) mottles; moderate medium angular blocky structure; firm; common fine roots; many distinct dark gray (10YR 4/1) clay films on faces of peds; few fine black iron and manganese concretions; medium acid; clear smooth boundary.

Bt4—43 to 54 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate coarse subangular blocky structure; firm; common fine roots; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; few fine black iron and manganese concretions; medium acid; clear smooth boundary.

C—54 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct dark yellowish brown (10YR 4/6) mottles; massive; friable; few fine roots; black (10YR 2/1) clay coatings in old root channels; few fine black iron and manganese concretions; medium acid.

The solum thickness ranges from 48 to 70 inches. Reaction is medium acid or strongly acid in the A and B horizons. The thickness of the mollic epipedon ranges from 16 to 28 inches.

The Ap and Al horizons are black (10YR 2/1) or very dark brown (10YR 2/2). The A horizon is silt loam or silty clay loam.

The upper part of the Bt horizon is dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) and has higher chroma mottles. The lower part has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2. The Bt horizons are silty clay loam or silty clay. The lower part of the B horizon and the C horizon have hue of 5Y to 7.5YR, value of 4 to 6, and chroma of 2 to 6 and are highly mottled.

Mandeville Series

The Mandeville series consists of moderately deep, moderately well drained, moderately permeable soils on uplands. These soils formed in residuum weathered from acid, silty shales. Slopes range from 5 to 14 percent.

Mandeville soils are commonly adjacent to McGirk, Menfro, and Snead soils. McGirk and Menfro soils have thicker solums than Mandeville soils and are on side slopes or ridgetops. Snead soils have a thick dark surface layer and are on side slopes. All of these soils are at higher elevations than Mandeville soils.

Typical pedon from an area of Mandeville silt loam, 5 to 14 percent slopes, 248 feet east and 2,145 feet north of the southwest corner of sec. 2, T. 47 N., R. 30 W.

A—0 to 4 inches; dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam; moderate fine granular structure; friable; many fine

and medium roots; slightly acid; clear smooth boundary.

E—4 to 7 inches; brown (10YR 5/3) silt loam; weak very fine granular structure; friable; many fine and medium roots; few wormcasts; strongly acid; clear smooth boundary.

Bt1—7 to 13 inches; brown (10YR 4/3) silty clay loam; weak very fine subangular blocky structure; friable; many fine and medium roots; brown (10YR 5/3) clay coatings on faces of peds; 10 to 15 percent shale fragments that are 5 to 10 millimeters in length; very strongly acid; clear smooth boundary.

Bt2—13 to 17 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine faint dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; friable; many fine and medium roots; common faint clay films on faces of peds; 10 to 15 percent shale fragments that are 5 to 10 millimeters in length; very strongly acid; clear smooth boundary.

BC—17 to 21 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct grayish brown (10YR 5/2) and common fine prominent olive (5Y 5/6) mottles; weak fine subangular blocky structure; firm; many fine and medium roots; 10 to 15 percent shale fragments that are 5 to 40 millimeters in length; very strongly acid; abrupt smooth boundary.

Cr—21 to 23 inches; yellowish brown (10YR 5/4) bedded shale that has interfaces of gray (10YR 5/1) and dark gray (10YR 4/1); few fine distinct yellowish brown (10YR 5/6) mottles; massive; very strongly acid.

The thickness of the solum ranges from 21 to 40 inches. Depth to soft shale bedrock ranges from 20 to 40 inches.

The A1 or Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. Reaction ranges from slightly acid to strongly acid.

The B horizon has hue of 10YR or 7.5YR, value of 4 through 6, and chroma of 3 through 6. Mottles that have chroma of 2 are absent in the lower part of the B horizon in some pedons. This horizon is silt loam, loam, or silty clay loam. The clay content averages 20 and 30 percent. The content of shale fragments ranges from 10 to 25 percent. Reaction ranges from very strongly acid through medium acid, and typically some part of the B horizon is strongly acid.

McGirk Series

The McGirk series consists of deep, poorly drained, slowly permeable soils on uplands. These soils formed in local colluvium and alluvium that is several feet deep. Slopes range from 5 to 9 percent.

McGirk soils are commonly adjacent to Greenton, Snead, and Weller soils. Greenton soils have a mollic epipedon and are in higher positions on the landscape than McGirk soils. Snead and Weller soils are moderately well drained and are also in higher positions than McGirk soils.

Typical pedon from an area of McGirk silt loam, 5 to 9 percent slopes, 1,500 feet south and 2,300 feet east of the northwest corner of sec. 19, T. 48 N., R. 29 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

BA—6 to 11 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine faint brown (10YR 4/3) mottles; weak very fine subangular blocky structure; firm; common fine roots; strongly acid; clear smooth boundary.

Btg1—11 to 17 inches; dark grayish brown (10YR 4/2) silty clay; common fine faint brown (10YR 4/3) and grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; very firm; common fine roots; common faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg2—17 to 24 inches; grayish brown (2.5Y 5/2) silty clay; few medium distinct dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; very firm; few fine roots; many faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Btg3—24 to 30 inches; dark grayish brown (10YR 4/2) silty clay; common fine faint grayish brown (10YR 5/2) and many fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few fine roots; many faint clay films on faces of peds; strongly acid; gradual smooth boundary.

Btg4—30 to 46 inches; grayish brown (2.5Y 5/2) silty clay; many fine prominent strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; very firm; few fine roots; many faint clay films on faces of peds; strongly acid; gradual smooth boundary.

BCg—46 to 57 inches; gray (10YR 5/1) silty clay; common medium distinct grayish brown (2.5Y 5/2) and many fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very firm; medium acid; clear smooth boundary.

Cg—57 to 66 inches; gray (10YR 5/1) silty clay loam; common medium distinct grayish brown (2.5Y 5/2) and many fine prominent strong brown (7.5YR 5/6) mottles; massive; firm; medium acid.

The thickness of the solum ranges from 45 to more than 70 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 1 or 2. Mottles are in hues of 10YR, 2.5Y, and 7.5YR, value of 4

through 6, and chroma of 2 through 6. The Bt horizon is silty clay or silty clay loam. Reaction is strongly acid or very strongly acid.

The BC and C horizons are mottled, gray silty clay or silty clay loam. Reaction is medium acid or strongly acid.

Menfro Series

The Menfro series consists of deep, well drained, moderately permeable soils on narrow ridgetops and convex side slopes. These soils commonly are along secondary drainageways. They formed in deposits of silty loess more than 6 feet thick. Slopes range from 2 to 14 percent.

Menfro soils are similar to Knox soils and are commonly adjacent to Oska, Sharpsburg, and Snead soils. Knox soils have a dark Ap or A1 horizon and are closer to the Missouri River bottom lands than Menfro soils. Oska and Snead soils are moderately deep to bedrock and are lower on the side slopes than Menfro soils. Sharpsburg soils have a thick dark surface layer and are on broader ridgetops at a slightly higher elevation than Menfro soils.

Typical pedon from an area of Menfro silt loam, 5 to 9 percent slopes, eroded, 990 feet north and 1,815 feet east of the southwest corner of sec. 9, T. 49 N., R. 30 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

Bt1—6 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few faint clay films on faces of some peds; strongly acid; clear smooth boundary.

Bt2—13 to 25 inches; dark brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; common faint clay films on faces of some peds; brown (10YR 5/3) silt coatings on some peds and old root channels; strongly acid; clear smooth boundary.

Bt3—25 to 41 inches; dark brown (7.5YR 4/4) silty clay loam; weak medium subangular blocky structure; firm; few faint clay films on faces of some peds; brown (10YR 5/3) silt coatings on some peds and old root channels; strongly acid; clear smooth boundary.

BC—41 to 49 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak coarse prismatic structure parting to weak coarse subangular blocky; firm; brown (10YR 5/3) silt coatings on some peds and old root channels; medium acid; clear smooth boundary.

C—49 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; massive; friable; thin clay films on some vertical cleavage faces; medium acid.

The thickness of the solum ranges from 38 to 70 inches.

The Ap or Al horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3.

The Bt horizon has hue of 10YR or 7.5YR, value of 4, and chroma of 3 or 4. The upper 20 inches of the argillic horizon averages 27 to 35 percent clay. Reaction ranges from strongly acid through slightly acid.

The C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or silty clay loam. Reaction is medium acid through neutral.

Modale Series

The Modale series consists of deep, somewhat poorly drained soils that are moderately permeable in the upper part of the profile and slowly permeable in the lower part. These soils formed in 18 to 30 inches of recently deposited silty alluvium underlain by clayey alluvium. Slopes range from 0 to 2 percent.

Modale soils are commonly adjacent to Gilliam, Haynie, and Leta soils. Gilliam and Haynie soils are not underlain by clayey material. Leta soils are clayey and are underlain by loamy material. All of these soils are at slightly lower elevations than Modale soils.

Typical pedon from an area of Modale silt loam, 2,640 feet north and 800 feet east of the southwest corner of sec. 3, T. 50 N., R. 3l W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; common fine roots and pores; neutral; abrupt smooth boundary.

C1—9 to 19 inches; dark grayish brown (10YR 4/2) very fine sandy loam; few fine faint grayish brown (10YR 5/2) mottles; massive; platy from stratification; very friable; few fine roots; very dark grayish brown (10YR 3/2) in thin lenses and old root channels; few very fine pores; slight effervescence; mildly alkaline; clear smooth boundary.

C2—19 to 29 inches; grayish brown (10YR 5/2) very fine sandy loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; platy from stratification; very friable; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

2C3—29 to 41 inches; mottled dark gray (10YR 4/1) and grayish brown (10YR 5/2) silty clay; few dark yellowish brown (10YR 3/4) stains; weak fine subangular blocky structure; very firm; slight effervescence; mildly alkaline; gradual smooth boundary.

2C4—41 to 60 inches; dark grayish brown (10YR 4/2) silty clay; moderate fine subangular blocky structure; faintly stratified; very firm; strong effervescence; moderately alkaline.

The thickness of the solum is less than 10 inches and corresponds to the thickness of the Ap horizon. Free carbonates commonly are throughout the profile but are absent in some Ap horizons.

The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. Reaction is neutral or mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. Individual strata have chroma of 3 or 4. Mottles have hue of 10YR to 5Y, value of 3 through 6, and chroma of 1 through 8. Reaction is mildly alkaline or moderately alkaline. The C horizon is silt loam or very fine sandy loam. The 2C horizon has hue of 10YR or 2.5Y, value of 3 through 5, and chroma of 1 or 2. Only the upper 10 inches of this horizon has value of 3. Mottles have hue of 10YR or 2.5Y. The 2C horizon is silty clay or clay. Reaction is mildly alkaline or moderately alkaline.

Napier Series

The Napier series consists of deep, well drained, moderately permeable soils on low toe slopes and alluvial fans. These soils formed in local alluvium washed from nearby loess soils. Slopes range from 0 to 3 percent.

Napier soils are similar to Kennebec soils and are commonly adjacent to Colo, Kennebec, Snead, and Zook soils. Colo and Zook soils are poorly drained and are at slightly lower elevations than Napier soils. Kennebec soils are moderately well drained. Snead soils are fine textured. They are on upland side slopes at a higher elevation than Napier soils.

Typical pedon from an area of Napier silt loam, 0 to 3 percent slopes, 2,450 feet south and 100 feet east of the northwest corner of sec. 23, T. 50 N., R. 31 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

A1—5 to 12 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; very dark grayish brown (10YR 3/2) crushed; very weak fine subangular blocky structure parting to weak fine granular; friable; common fine roots; medium acid; clear smooth boundary.

A2—12 to 22 inches; black (10YR 2/1) silt loam, gray (10YR 5/2) dry; very dark grayish brown (10YR 3/2) crushed; weak medium subangular blocky structure; friable; few very fine roots; few fine pores; neutral; clear smooth boundary.

Bw1—22 to 32 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; friable; few very fine roots; few fine pores; neutral; gradual smooth boundary.

Bw2—32 to 39 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; few fine pores; neutral; gradual smooth boundary.

BC—39 to 48 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; common fine pores; neutral; gradual smooth boundary.

C—48 to 60 inches; brown (10YR 4/3) silt loam; massive; friable; common fine pores; mildly alkaline.

The thickness of the solum ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 24 to 40 inches. Texture is silt loam throughout the solum.

The A horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction ranges from medium acid to neutral.

The B horizons have hue of 10YR, value of 3, and chroma of 3, grading to hue of 10YR, value of 4, and chroma of 3 in the lower part. Reaction is neutral or slightly acid.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Reaction is neutral to moderately alkaline.

Oska Series

The Oska series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in residuum weathered from limestone and calcareous shales. Slopes range from 5 to 9 percent.

These Oska soils have a thinner dark surface layer than is definitive for the Oska series. This difference, however, does not significantly affect the use or management of the soils.

Oska soils are similar to Polo soils and commonly are adjacent to Polo, Sharpsburg, and Snead soils. Polo soils are deeper to limestone than Oska soils. Sharpsburg soils are deep and moderately well drained. They are on ridgetops at a higher elevation than Oska soils. Snead soils are moderately well drained. They do not have argillic horizons or red hue, and they are downslope from Oska soils.

Typical pedon from an area of Oska silty clay loam, 5 to 9 percent slopes, eroded, 1,625 feet east and 375 feet south of the northwest corner of sec. 35, T. 49 N., R. 31 W.

A—0 to 3 inches; dark brown (7.5YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure parting to weak medium granular; friable; many roots; medium acid; clear smooth boundary.

BA—3 to 7 inches; dark reddish brown (5YR 3/3) silty clay loam, dark brown (7.5YR 4/2) dry; dark brown (7.5YR 3/2) crushed; moderate very fine subangular blocky structure; friable; many roots; dark brown coatings on faces of peds; medium acid; clear smooth boundary.

Bt1—7 to 12 inches; dark reddish brown (5YR 3/4) silty clay loam; moderate very fine subangular blocky structure; friable; many roots; few faint dark reddish brown (5YR 3/3) coatings on faces of peds; medium acid; clear smooth boundary.

Bt2—12 to 22 inches; reddish brown (5YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; many roots; common faint dark reddish brown (5YR 3/4) clay films on faces of peds; medium acid; clear smooth boundary.

Bt3—22 to 28 inches; brown (7.5YR 4/4) cherty silty clay; moderate fine subangular blocky structure; firm; common roots; few faint reddish brown (5YR 4/4) clay films on faces of peds; 30 percent angular chert fragments; medium acid; clear smooth boundary.

Bt4—28 to 32 inches; brown (7.5YR 4/4) silty clay loam; weak fine subangular blocky structure; firm; common roots; brown (7.5YR 4/2) clay films on faces of peds; common fine brownish yellow (10YR 6/6) weathered shale fragments; few angular chert fragments; medium acid; clear smooth boundary.

BC—32 to 34 inches; yellowish brown (10YR 5/6) silty clay loam; weak very fine subangular blocky structure; firm; few roots; brown (7.5YR 4/4) coatings on faces of peds; slight effervescence; mildly alkaline; abrupt smooth boundary.

R—34 inches; hard limestone rock.

The thickness of the solum and depth to limestone bedrock range from 20 to 40 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 2. It ranges from 6 to 9 inches in thickness.

The Bt horizon has hue of 7.5YR or 5YR, value of 3 through 5, and chroma of 3 through 6. It is clay, silty clay, or silty clay loam. Reaction is medium acid to neutral. The control section averages 35 to 50 percent clay.

The BC horizon has hue of 10YR through 5YR, value of 4 through 6, and chroma of 4 through 8. It is clay, silty clay, or silty clay loam.

Parkville Series

The Parkville series consists of deep, somewhat poorly drained soils on the Missouri River flood plain. Permeability is slow in the upper part of the profile and moderate in the lower part. These soils formed in recent calcareous alluvium. Slopes range from 0 to 2 percent.

Parkville soils are similar to Leta soils and commonly are adjacent to Gilliam, Haynie, and Leta soils. Gilliam and Haynie soils do not have clayey surface layers. They are at a slightly higher elevation than Parkville soils. Leta soils are clayey to a depth of more than 20 inches.

Typical pedon from an area of Parkville silty clay, 2,400 feet west and 1,700 feet south of the northeast corner of sec. 21, T. 50 N., R. 33 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate very fine granular structure; very firm; many fine and very fine roots; mildly alkaline; abrupt smooth boundary.

A—7 to 17 inches; very dark gray (10YR 3/1) silty clay, grayish brown (10YR 5/2) dry; moderate very fine angular blocky structure; very firm; common fine and very fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

2C1—17 to 33 inches; grayish brown (10YR 5/2) very fine sandy loam; few fine prominent dark brown (7.5YR 4/4) mottles; 3-inch stratum of very dark gray (10YR 3/1) silty clay loam at the bottom of this horizon; massive; very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

2C2—33 to 60 inches; grayish brown (10YR 5/2) stratified fine sand, loamy fine sand, and silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; massive; loose; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 12 to 20 inches. Free carbonates typically are below a depth of 10 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizons have hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. They are silty clay or silty clay loam that averages more than 35 percent clay. Reaction is neutral or mildly alkaline.

The 2C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. These horizons have brownish or grayish mottles. The 2C horizons are stratified silt loam, very fine sand, or loamy fine sand, and they typically have thin strata of fine or coarse material in the lower part of the control section. Reaction is mildly alkaline or moderately alkaline.

Polo Series

The Polo series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty loess and residuum weathered from limestone or shale. Slopes range from 2 to 9 percent.

Polo soils are similar to Sharpsburg and Sibley soils and commonly are adjacent to Oska, Sharpsburg, and Snead soils. Oska soils have a lithic contact within a depth of 40 inches. They are on side slopes and are at a lower elevation than Polo soils. Sharpsburg and Sibley soils do not have reddish hues in the lower part of the Bt horizon. They are on ridgetops at higher elevations than Polo soils. Snead soils are moderately deep. They are on side slopes at a lower elevation than Polo soils.

Typical pedon from an area of Polo silt loam, 2 to 5 percent slopes, 230 feet east and 2,100 feet south of the northwest corner of sec. 16, T. 47 N., R. 32 W.

Ap—0 to 6 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A—6 to 14 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; many fine roots; medium acid; clear smooth boundary.

Bt1—14 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—19 to 26 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate very fine subangular blocky structure; firm; common fine roots; common faint very dark grayish brown (10YR 3/2) clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3—26 to 36 inches; brown (10YR 4/3) silty clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; common faint dark brown (10YR 3/3) clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt4—36 to 45 inches; brown (10YR 4/3) silty clay loam; few fine prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few faint dark brown (10YR 3/3) clay films on faces of peds; strongly acid; gradual smooth boundary.

2Bt5—45 to 54 inches; yellowish red (5YR 4/6) silty clay loam; moderate medium subangular blocky structure; firm; few faint dark brown (7.5YR 3/3) clay films on faces of peds; strongly acid; clear smooth boundary.

2BC—54 to 67 inches; yellowish red (5YR 4/8) silty clay loam; moderate coarse subangular blocky structure; firm; strongly acid; clear smooth boundary.

The solum thickness ranges from 4 to 8 feet. Depth to bedrock is more than 60 inches. The mollic epipedon extends into the argillic horizon and ranges from 20 to 30 inches in thickness.

The A horizon commonly has hue of 10YR, value of 2 or 3, and chroma of 2 or 3; however, it has hue of 7.5YR in some pedons. The A horizon is silt loam or silty clay loam. Reaction is slightly acid or medium acid.

The Bt horizon has hue of 10YR or 7.5YR, value of 3 in the upper part and 4 or 5 in the lower part, and chroma of 2 through 4. It is silty clay loam or silty clay. Reaction is slightly acid to strongly acid. The 2B horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 through 8. Some pedons have a few gravel size fragments. The 2B horizon is silty clay or silty clay loam. Reaction is slightly acid to strongly acid.

Polo silt loam, 5 to 9 percent slopes, eroded, has a thinner dark surface layer than is defined for the Polo series. This difference, however, does not significantly affect the use or management of the soil.

Sampsel Series

The Sampsel series consists of deep, poorly drained, slowly permeable soils on uplands. These soils formed in residuum weathered from shale and limestone. Slopes range from 2 to 9 percent.

Sampsel soils are similar to Bremer soils and commonly are adjacent to Greenton, Macksburg, and Snead soils. Bremer soils are nearly level. Greenton soils are moderately well drained and are on side slopes. Macksburg soils have less clay in the control section and are on broad ridgetops. Snead soils are moderately deep and are on side slopes. The Greenton, Macksburg, and Snead soils are at higher elevations than Sampsel soils.

Typical pedon from an area of Sampsel silty clay loam, 2 to 5 percent slopes, 700 feet east and 1,800 feet south of the northwest corner of sec. 22, T. 47 N., R. 31 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; firm; common fine roots; medium acid; abrupt smooth boundary.

BA—7 to 15 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate very fine subangular blocky structure; firm; common fine roots; medium acid; clear smooth boundary.

Bt1—15 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate very fine angular blocky structure; very firm; few fine roots; many faint very dark gray (10YR 3/1) clay films on faces of peds; common fine iron and manganese concretions; medium acid; gradual smooth boundary.

Bt2—22 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct olive brown (2.5Y 4/4) mottles; moderate medium columnar structure parting to moderate medium subangular blocky; very firm; few fine roots; many faint very dark gray (10YR 3/1) clay films on faces of peds; common fine iron and manganese concretions; medium acid; gradual smooth boundary.

Bt3—31 to 60 inches; gray (5Y 5/1) silty clay; common fine prominent dark yellowish brown (10YR 4/6), few fine distinct olive brown (2.5Y 4/4), and few medium distinct gray (10YR 5/1) mottles; moderate medium columnar structure parting to weak medium and coarse subangular blocky; very firm; common faint clay films on faces of peds; common fine iron and manganese concretions; slightly acid.

The thickness of the solum ranges from 36 to 70 inches, and depth to soft bedrock ranges from 40 to 70

inches. The mollic epipedon ranges from 10 to 20 inches in thickness. It includes all of the A horizon and generally includes the upper part of the B horizon.

The A and BA horizons have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The Ap horizon typically is silty clay loam, but the range includes silt loam.

The Bt horizon has hue of 10YR through 5Y, value of 4 or 5, and chroma of 1 or 2. Mottles are of higher chroma. The Bt horizon averages 36 to 48 percent clay. Reaction ranges from medium acid to moderately alkaline.

Sarpy Series

The Sarpy series consists of deep, excessively drained, very rapidly permeable soils on the Missouri River bottom lands. These soils formed in sandy alluvium. Slopes range from 0 to 2 percent.

Sarpy soils commonly are adjacent to Haynie, Leta, and Parkville soils. Haynie soils are coarse-silty and are moderately permeable. Leta and Parkville soils have silty clay surface layers and are somewhat poorly drained. All of these soils are at slightly lower elevations than Sarpy soils.

Typical pedon from an area of Sarpy fine sand, 300 feet west and 600 feet south of the northeast corner of sec. 26, T. 51 N., R. 30 W.

Ap—0 to 6 inches; dark brown (10YR 4/3) fine sand; single grained; loose; many fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—6 to 42 inches; grayish brown (10YR 5/2) fine sand; single grained; loose; common fine roots; thin bands of dark grayish brown (10YR 4/2) very fine sand at bottom of horizon; slight effervescence; mildly alkaline; clear smooth boundary.

C2—42 to 60 inches; grayish brown (10YR 5/2) fine sand; single grained; loose; few fine roots; few thin bands of silt and very fine sand; slight effervescence; mildly alkaline.

Reaction is neutral to moderately alkaline throughout the profile. Most pedons have free carbonates throughout the control section.

The Ap or A1 horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The C horizon is stratified.

Sharpsburg Series

The Sharpsburg series consists of deep, moderately well drained soils on uplands. Permeability is moderately slow. These soils formed in deep, silty loess. Slopes range from 2 to 9 percent.

Sharpsburg soils are similar to Polo and Sibley soils and commonly are adjacent to Higginsville and Macksburg soils. Higginsville soils are somewhat poorly drained. They are on side slopes and are at a lower elevation than Sharpsburg soils. Macksburg soils are somewhat poorly drained. They are on broader ridgetops than Sharpsburg soils and also are at a lower elevation. Polo soils have a thicker mollic epipedon than Sharpsburg soils and are of redder hue in the lower part of the solum. Sibley soils have a thicker mollic epipedon and are on ridgetops at a higher elevation.

Typical pedon from an area of Sharpsburg silt loam, 2 to 5 percent slopes, 1,485 feet south and 1,525 feet east of the northwest corner of sec. 10, T. 47 N., R. 30 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A—6 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

AB—13 to 21 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark brown (10YR 3/3) kneaded, brown (10YR 5/3) dry; moderate medium granular structure; friable; common fine roots; strongly acid; clear smooth boundary.

Bt1—21 to 28 inches; dark brown (10YR 4/3) silty clay loam; common fine distinct dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; firm; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; common fine roots; strongly acid; clear smooth boundary.

Bt2—28 to 35 inches; dark brown (10YR 4/3) silty clay loam; common fine distinct dark yellowish brown (10YR 4/6) and common fine prominent grayish brown (2.5Y 5/2) mottles in the lower part; moderate medium subangular blocky structure; firm; common faint dark grayish brown (10YR 4/2) clay films on faces of peds; few organic stains; common fine roots; strongly acid; gradual smooth boundary.

Bt3—35 to 47 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium faint dark yellowish brown (10YR 4/6) and common medium distinct grayish brown (2.5Y 5/2) mottles; moderate coarse subangular blocky structure; firm; few faint dark grayish brown (10YR 4/2) clay films on faces of peds; few fine roots; medium acid; gradual smooth boundary.

C—47 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (2.5Y 5/2) mottles; massive; firm; few fine roots; neutral.

The thickness of the solum ranges from 42 to 60 inches. The thickness of the mollic epipedon ranges from 10 to 24 inches. Reaction is medium acid or

strongly acid in the B horizon and lower part of the A horizon and slightly acid or neutral in the C horizon.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 2.

The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. The lower part of the Bt horizon has mottles that have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 through 6 or mottles that have hue of 2.5Y or 5Y, value of 4 through 6, and chroma of 2 below a depth of 32 inches.

The BC and C horizons have mottles that have hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 through 6.

Sibley Series

The Sibley series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty loess that is several feet thick. Slopes range from 2 to 9 percent.

Sibley soils are similar to Sharpsburg and Polo soils and commonly are adjacent to Higginsville, Knox, and Sharpsburg soils. Higginsville soils are somewhat poorly drained. They are on side slopes and are at a lower elevation than Sibley soils. Knox soils do not have a mollic epipedon. They are on slopes that are closer to the Missouri River flood plains than Sibley soils. Polo soils are of redder hue in the lower part of the solum than Sibley soils. Sharpsburg soils have a mollic epipedon less than 24 inches thick. They have more clay in the argillic horizon and are at a lower elevation than Sibley soils.

Typical pedon from an area of Sibley silt loam, 2 to 5 percent slopes, 60 feet west and 330 feet north of the southeast corner of sec. 29, T. 49 N., R. 29 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium and fine granular structure; friable; many fine roots; common medium and fine root channels; common very dark grayish brown (10YR 3/2) wormcasts; neutral; abrupt smooth boundary.

A—7 to 15 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; many fine roots; common medium and fine root channels; few very dark grayish brown (10YR 3/2) wormcasts; slightly acid; clear smooth boundary.

AB—15 to 24 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; many fine roots; few root channels; neutral; clear smooth boundary.

Bt1—24 to 32 inches; dark brown (10YR 3/3) silty clay loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; firm; common fine roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; few faint clay films; slightly acid; clear smooth boundary.

Bt2—32 to 41 inches; brown (10YR 4/3) silty clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; very dark grayish brown (10YR 3/2) coatings on vertical faces of peds; few faint clay films; medium acid; clear smooth boundary.

Bt3—41 to 54 inches; brown (10YR 4/3) silty clay loam; common fine distinct yellowish brown (10YR 5/6) and common fine faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; very dark grayish brown (10YR 3/2) coatings on vertical faces of peds; thick discontinuous clay films; medium acid; gradual smooth boundary.

Bt4—54 to 66 inches; mottled dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/6), and grayish brown (10YR 5/2) silty clay loam; weak coarse subangular blocky structure; firm; dark grayish brown (10YR 4/2) coatings on vertical faces of peds; common patchy brown (7.5YR 4/2) clay films; slightly acid; gradual smooth boundary.

C—66 to 76 inches; mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and dark yellowish brown (10YR 4/4) silt loam; massive; friable; slightly acid.

The solum ranges from 46 to more than 65 inches in thickness. The mollic epipedon ranges from 24 to 36 inches in thickness and includes the upper part of the argillic horizon. The upper 20 inches of the argillic horizon averages 32 to 35 percent clay. Reaction typically ranges from medium acid to neutral.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. It is silt loam in the upper part and silt loam or silty clay loam in the lower part.

The B horizon has hue of 10YR. It has value of 3 and chroma of 2 or 3 in the upper part and value of 3 through 5 and chroma of 3 or 4 in the lower part. There are no mottles or matrix colors that have chroma of 2 in that part of the B horizon within a depth of 36 inches.

The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Mottles have hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. The C horizon is silt loam or silty clay loam.

Snead Series

The Snead series consists of moderately deep, moderately well drained, slowly permeable soils on uplands. These soils formed in residuum weathered from calcareous, clayey shales and thin interbedded limestone. Slopes range from 5 to 30 percent.

Snead soils are commonly adjacent to Oska, Polo, and Sampsel soils. Oska soils have a reddish subsoil. They are well drained and are upslope from Snead soils. Polo soils are deep. They have a red subsoil and also are

upslope from Snead soils. Sampsel soils are deep. They are somewhat poorly drained and are downslope from Snead soils.

Typical pedon of Snead flaggy silty clay loam from an area of Snead-Rock outcrop complex, 5 to 14 percent slopes, 2,060 feet west and 1,570 feet north of the southeast corner of sec. 10, T. 47 N., R. 30 W.

A—0 to 10 inches; black (10YR 2/1) flaggy silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; firm; many fine and medium roots; about 20 percent limestone fragments ranging from 1 to 15 inches in length; neutral; clear smooth boundary.

AB—10 to 14 inches; very dark grayish brown (10YR 3/2) flaggy silty clay loam, dark grayish brown (10YR 4/2) dry; weak medium angular blocky structure parting to moderate fine granular; firm; many fine and medium roots; about 20 percent limestone fragments 6 to 15 inches in length; slight effervescence; mildly alkaline; clear smooth boundary.

Bw1—14 to 23 inches; dark grayish brown (2.5Y 4/2) silty clay; weak very fine subangular blocky structure; firm; common fine and medium roots; few calcium concretions; strong effervescence; moderately alkaline; clear smooth boundary.

Bw2—23 to 30 inches; olive (5Y 5/3) silty clay; common fine distinct light olive brown (2.5Y 5/4) and gray (N 5/0) mottles; moderate medium subangular blocky structure; firm; common fine and medium roots; strong effervescence; moderately alkaline; clear smooth boundary.

Cr1—30 to 35 inches; yellowish brown (10YR 5/6) soft shale; strong effervescence; moderately alkaline; abrupt smooth boundary.

Cr2—35 to 45 inches; black (10YR 2/1) soft shale that gradually becomes harder with depth; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 40 inches, and depth to soft shale bedrock ranges from 20 to 40 inches. Depth to free carbonates ranges from 12 to 20 inches. Reaction is slightly acid or neutral in the upper part of the solum and ranges from neutral to moderately alkaline in the lower part.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silty clay loam, but silt loam is within the range. It is 15 to 25 percent limestone fragments ranging from 6 to 15 inches in length.

The B horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5, and chroma of 2 through 6. It is silty clay or clay.

The C horizons have colors and textures similar to those of the B horizons.

Wabash Series

The Wabash series consists of deep, very poorly drained, very slowly permeable soils on large flood plains. These soils formed in fine textured alluvium. Slopes range from 0 to 2 percent.

Wabash soils are similar to Zook soils and commonly are adjacent to Colo, Kennebec, and Zook soils. All of these soils are between Wabash soils and the stream channels and have less than 45 percent clay in the 10- to 40-inch control section.

Typical pedon from an area of Wabash silty clay, 1,700 feet north and 1,500 feet east of the southwest corner of sec. 3, T. 49 N., R. 31 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine granular structure; firm; common fine roots; medium acid; abrupt smooth boundary.

A1—7 to 11 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak very fine angular and subangular blocky structure; very firm; few fine roots; slightly acid; clear smooth boundary.

A2—11 to 29 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine angular and subangular blocky structure; very firm; few fine roots; slightly acid; clear smooth boundary.

BA—29 to 39 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; very firm; few fine roots; neutral; clear smooth boundary.

Bg1—39 to 49 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; few fine prominent dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; very firm; neutral; clear smooth boundary.

Bg2—49 to 55 inches; dark gray (10YR 4/1) silty clay; few fine prominent dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; neutral; clear smooth boundary.

Bg3—55 to 60 inches; very dark gray (10YR 3/1) silty clay; few fine prominent dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; very firm; neutral.

The thickness of the solum ranges from 40 to more than 60 inches. Depth to free carbonates is more than 60 inches. The thickness of the mollic epipedon is 36 inches or more.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction ranges from medium acid to neutral.

The B horizon to a depth of 36 inches or more has a range of color similar to that of the A horizon. It has hue of 10YR through 5Y, value of 2 through 5, and chroma of 1 and 2 below a depth of 36 inches. The mottles in the B horizon have hue of 7.5YR or yellower and have

higher chroma than the matrix. Reaction ranges from slightly acid to mildly alkaline. The 10- to 40-inch control section averages 46 to 60 percent clay.

Weller Series

The Weller series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in silty loess. Slopes range from 2 to 5 percent.

Weller soils are commonly adjacent to Greenton, McGirk, and Menfro soils. Greenton soils have a mollic epipedon and are downslope from the Weller soils. McGirk soils are somewhat poorly drained and also are downslope from Weller soils. Menfro soils are well drained, have less clay in the argillic horizon, and are upslope from Weller soils.

Typical pedon from an area of Weller silt loam, 2 to 5 percent slopes, 1,400 feet south and 50 feet west of the northeast corner of sec. 8, T. 47 N., R. 29 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate very fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

A—7 to 16 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

E—16 to 21 inches; brown (10YR 5/3) silt loam; weak medium platy structure parting to weak medium granular; friable; few roots; slightly acid; abrupt smooth boundary.

Bt1—21 to 28 inches; yellowish brown (10YR 5/4) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; light brownish gray (10YR 6/2) coatings on faces of peds in the upper part; slightly acid; clear smooth boundary.

Bt2—28 to 37 inches; mottled dark grayish brown (10YR 4/2) and strong brown (7.5YR 5/6) silty clay loam; moderate fine subangular blocky structure; firm; common faint clay films on faces of peds; few roots; very strongly acid; clear smooth boundary.

Bt3—37 to 50 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) silty clay; moderate medium subangular blocky structure; firm; common thin clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt4—50 to 60 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) silty clay loam; weak coarse subangular blocky structure; firm; few faint grayish brown (10YR 5/2) clay films on faces of peds; medium acid; gradual smooth boundary.

C—60 to 70 inches; mottled grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) silty clay loam; massive; firm; black iron and manganese stains on old pressure faces; slightly acid.

The solum is typically 60 or more inches thick. It is strongly acid or very strongly acid in the most acid part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 1 through 3. It is mostly silt loam, but in eroded places it is silty clay loam. The E horizon is grayish brown (10Y 5/2), brown (10YR 5/3), or dark grayish brown (10YR 4/2).

The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 4. Mottles are in hue of 7.5YR through 2.5Y, value of 4 or 5, and chroma of 2 through 6. Mottles that have chroma of 2 are within the upper 10 inches of the argillic horizon; however, a mottle-free zone is below the Ap horizon. The maximum content of clay in the Bt horizon is 42 to 48 percent.

Wiota Series

The Wiota series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium washed from loess-covered uplands. Slopes range from 0 to 2 percent.

Wiota soils are similar to Cotter soils and are commonly adjacent to Bremer, Snead, and Zook soils. Bremer and Zook soils are poorly drained. They are at lower elevations than Wiota soils. Cotter soils have less clay in the lower part of the solum. Snead soils are moderately deep and are on adjacent uplands.

Typical pedon from an area of Wiota silt loam, 1,400 feet north and 180 feet east of the southwest corner of sec. 35, T. 50 N., R. 31 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—6 to 12 inches; black (10YR 2/1) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine granular structure; friable; common fine roots; few wormcasts; slightly acid; clear smooth boundary.

BA—12 to 21 inches; very dark grayish brown (10YR 3/2) silty clay loam, brown (10YR 5/3) dry; weak very fine subangular blocky structure; friable; few fine roots; slightly acid; clear smooth boundary.

Bt1—21 to 29 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; friable; few fine roots; few distinct very dark brown (10YR 2/2) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—29 to 39 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; friable; few fine roots; few distinct very dark brown (10YR 2/2) clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt3—39 to 46 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; friable; few faint dark brown (10YR 3/3)

clay films on faces of some peds; medium acid; clear smooth boundary.

C—46 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct grayish brown (10YR 5/2) and few fine distinct strong brown (7.5YR 4/6) mottles; massive; medium acid.

The thickness of the solum ranges from 36 to 60 inches. Reaction ranges from slightly acid to strongly acid. The mollic epipedon ranges from about 18 to 32 inches in thickness and includes the upper part of the B horizon in most pedons.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is silt loam or silty clay loam.

The upper part of the Bt horizon is dark brown (10YR 3/3). The lower part of the Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is 32 to 36 percent clay.

The C horizon has matrix colors similar to those of the Bt2 horizon. Some pedons, however, have mottles of both low and high chroma. The C horizon is typically silty clay loam.

Zook Series

The Zook series consists of deep, poorly drained, slowly permeable soils on flood plains. These soils formed in thick deposits of silty and clayey alluvium. Slopes range from 0 to 2 percent.

Zook soils are similar to Colo and Wabash soils and commonly are adjacent to Bremer, Colo, Kennebec, and Wiota soils. Bremer and Wiota soils have argillic horizons. They are on benches at higher elevations than Zook soils. In addition, Wiota soils are well drained. Colo and Kennebec soils have less clay in the control section than Zook soils. In addition, Kennebec soils are moderately well drained, are at a slightly higher elevation, and are nearer the stream channel. Wabash soils have more clay than Zook soils.

Typical pedon from an area of Zook silty clay loam, 1,400 feet east and 1,400 feet north of the southwest corner of sec. 4, T. 49 N., R. 31 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A1—8 to 17 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few fine roots; few fine pores; slightly acid; clear smooth boundary.

A2—17 to 25 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; medium acid; gradual smooth boundary.

A3—25 to 41 inches; black (10YR 2/1) silty clay, gray (10YR 5/1) dry; moderate fine angular and subangular blocky structure; firm; medium acid; clear smooth boundary.

Bg—41 to 52 inches; dark gray (10YR 4/1) silty clay; few fine prominent dark brown (7.5YR 4/4) mottles; moderate fine and medium angular blocky structure; firm; very dark gray (10YR 3/1) coatings on faces of peds; medium acid; clear smooth boundary.

Cg—52 to 60 inches; dark gray (10YR 4/1) silty clay; common medium faint very dark gray (10YR 3/1) mottles and coatings on vertical cleavage faces; few fine prominent dark brown (7.5YR 4/4) mottles; massive; firm; some vertical cleavage faces; slightly acid.

The solum ranges from 40 to 60 inches in thickness. It is silty clay loam or silty clay that is 36 to 45 percent clay. Reaction is medium acid or slightly acid. The mollic epipedon ranges from 36 to 50 inches in thickness.

The A horizon is black (10YR 2/1 or N 2/0) in the upper part and black (10YR 2/1 or N 2/0) or very dark gray (10YR 3/1) in the lower part.

The B and C horizons have hue of 10YR, value of 3 through 5, and chroma of 1. Brown mottles are in some pedons.

Formation of the Soils

This section describes the factors of soil formation and relates them to the formation of soils in the survey area.

Factors of Soil Formation

Soil is the product of soil-forming processes acting on accumulated or deposited geologic materials. The characteristics of the soil are determined by (1) the type of parent material, (2) the plant and animal life on and in the soil, (3) the climate under which the soil-forming factors were active, (4) the topography, or lay of the land, and (5) the length of time those forces have been active.

The parent material affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Plant and animal life, chiefly plants, are active in soil formation. The climate determines the amount of water available for leaching and the amount of heat for physical and chemical changes. Together, climate and plant and animal life act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. Relief often modifies these other factors. Finally, time is required for changes to be made so that parent material becomes soil. Generally, a long time is required for the development of distinct soil horizons.

These factors of soil formation are so closely interrelated in their effect on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified for the other four. Soil formation is complex, and many processes of soil development are still unknown.

Parent Material

Parent material is the unconsolidated mass from which soil is formed. The deposition or formation of this material is the first step in the development of a soil profile. The characteristics of this material determine the limits of chemical and mineralogical composition of the soil. In Jackson County, three kinds of parent material, alone or in combination with two or more kinds of material, have contributed to the formation of the soils. They are residual material weathered from bedrock, loess or wind-deposited material, and alluvial or water-deposited material.

Residual parent material consists of three types; limestone, shale, and shale with interbedded limestone. Oska and Polo soils formed in limestone residuum. Snead and Greenton soils formed in residuum weathered from shale interbedded with limestone. Mandeville soils formed in shale residuum. In addition, Polo and Greenton soils have a thin loess cap that covers the residual material.

Loess is material transported by wind. It is the most extensive parent material in Jackson County. The principal source of loess is believed to be the Missouri River flood plain, which resulted after the retreat of the last glacier. The deepest deposits of loess are on the uplands bordering this flood plain. In these uplands loess is the parent material from which the well drained Knox, Menfro, and Sibley soils developed. Further from the flood plain, deposits are thinner and contain more clay. In these areas finer textured parent material and more gentle slopes have resulted in soils that have more restricted drainage. Sharpsburg and Macksburg soils are examples.

Alluvium is material that was transported by water and deposited on nearly level flood plains. Because of its diverse origins and the varying speed of the flowing water, this material differs greatly in texture and mineralogical composition. Haynie and Sarpy soils formed in parent material that was deposited while the water had sufficient flow and velocity to carry sand-size particles. The finer textured Zook, Wabash, and Leta soils formed in material that was deposited in slack water areas.

Plant and Animal Life

Plants and animals living on or in the soil are active in the soil-forming process. Plants furnish organic matter to the soil and bring up nutrients from underlying layers to the surface layer. When these plants die and decay, they contribute organic matter to the soil. Bacteria and fungi decompose the plant remains and help to incorporate the organic matter into the soil.

The kind of native vegetation has greatly influenced soil formation in Jackson County. The organic matter added to the soils under prairie grasses is largely the result of the yearly decomposition of plant material. Plant tops decompose at the surface, but a large part of the plant material is roots that decompose at various depths in the soil. The soils formed under prairie grasses therefore have a thick, dark surface layer. Sibley,

Sharpsburg, and Higginsville soils are examples of soils formed under prairie grasses.

The amount of organic matter added to the soils under trees is small. It is mostly the result of the decomposition of leaves and twigs on the surface. The soils formed under forest therefore have a thin, dark surface layer. Knox and Menfro soils are examples of forest soils.

Insects, animals, and man also affect the soil. Bacteria and fungi contribute more than animals contribute to the formation of soils. They cause rotting of organic material, fix nitrogen in the soil, and improve tilth. Burrowing animals and insects loosen and mix the various soil horizons.

Man in a short time has greatly affected the soil-forming process. Major alterations have resulted from changes in vegetation, drainage, accelerated erosion, and urban buildup. Row crops have replaced many of the native grasses and forested areas. The changes in vegetation have affected the drainage of the soil and have accelerated erosion. Urban buildup has covered areas of farmland with houses and concrete. At present, erosion continues to reduce the potential of many upland soils, and the loss of cropland to urban development is irreversible.

Climate

Climate has been an important factor in soil formation. Geologic erosion, the kinds of plant and animal life, and, more recently, accelerated erosion have varied with the climate. At present, climatic conditions favor the growth of trees more than the growth of prairie grasses. The prairies in Jackson County were the result of a drier climate.

The glacial periods greatly affected soil formation. The glaciers were the result of climatic changes. Thousands of years of cold temperatures produced the glaciers that moved into the survey area. The advent of warmer weather and high winds caused severe geologic erosion, and much of Jackson County was covered with loess.

High temperatures and adequate rainfall encourage rapid chemical and physical changes in the soil. They contribute to the breakdown of minerals and the formation of clay within the soil. This clay moves downward into the soil profile and forms the subsoil. Nearly all of the upland soils show evidence of this eluviation.

Topography

Topography, or lay of the land, affects soil formation through its influence on drainage, runoff, infiltration, and accelerated erosion. The length, shape, aspect, and gradient of slopes are important in determining the pattern and distribution of soils.

The amount of water entering the soil depends on the steepness of slope, permeability, and intensity of rainfall. On steep areas where runoff is rapid, very little water passes through the soil and soil formation is slow. In these areas, geologic erosion almost keeps pace with the soil-forming processes. On gently sloping areas, however, erosion is minimal, runoff is slow, and most of the water passes through the soil. These factors intensify leaching, cause translocation of clay, and bring about other soil-forming processes. Soils formed on gently sloping areas have maximum profile development.

Soils on south-facing slopes receive the sun's rays more directly and are more droughty than soils on north-facing slopes. Droughtiness influences soil formation through its effect on the kind of vegetation, erosion, and freezing and thawing.

Time

The age of a soil is determined by the degree of development of a soil profile. It is the result of the interaction of soil-forming processes over a period of time, not just the years the material has existed.

The degree of profile development is dependent on the length of time that the parent material has been in place and is subject to soil-forming processes. Older soils that show the effects of leaching and clay movement have distinct horizons. Young soils show little profile development.

The alluvial soils are the youngest soils in Jackson County. Haynie and Gilliam soils have no profile development because alluvial material has been added every year until recently. Bremer and Wiota soils on stream terraces are older alluvial soils. These soils show profile development.

The oldest soils in the survey area formed in loess on the higher elevations. Macksburg and Sharpsburg soils show development of distinct horizons. Clay has been concentrated into distinct subsoil horizons through weathering and translocation by water.

The steep, shallower soils, such as Snead soils, are young soils. The shale and limestone from which the parent material formed is much older than the parent material of other soils, but the removal of material through geological erosion has nearly kept pace with the soil-forming processes. As a result, these soils are considered young.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is

not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough

during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Green chop. The cutting and hauling of green herbage to animals that are generally confined to a dry lot. Also called zero grazing.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2)

granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage(in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded and 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.
Substratum. The part of the soil below the solum.
Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.
Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."
Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.
Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.
Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.
Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."
Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.
Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.
Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.
Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.
Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.
Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.
Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.
Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-79 at Kansas City, Missouri]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	37.8	19.8	28.8	69	-6	0	1.17	0.28	1.87	3	6.9
February---	43.5	25.1	34.3	73	-1	10	1.28	.57	1.88	4	4.1
March------	52.7	32.8	42.8	84	9	65	2.51	1.19	3.64	6	5.1
April------	66.6	45.7	56.2	89	26	217	3.34	1.94	4.58	7	.7
May--------	76.6	56.8	66.7	93	37	518	4.12	2.89	5.25	7	.0
June-------	85.0	66.3	75.7	99	50	771	5.18	2.77	7.30	8	.0
July-------	89.2	70.8	80.0	103	56	930	4.42	1.54	6.80	7	.0
August-----	88.5	69.2	78.9	103	55	896	3.69	1.37	5.62	6	.0
September--	81.2	60.7	71.0	98	42	630	4.08	1.17	6.42	6	.0
October----	70.3	49.5	59.9	91	30	333	3.02	.94	4.71	5	.0
November---	54.8	35.9	45.4	78	14	46	1.56	.26	2.54	3	.9
December---	42.8	26.2	34.5	68	0	12	1.38	.48	2.12	4	4.5
Yearly:											
Average--	65.8	46.6	56.2	---	---	---	---	---	---	---	---
Extreme--	---	---	---	104	-6	---	---	---	---	---	---
Total----	---	---	---	---	---	4,428	35.75	27.58	44.29	66	22.2

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-79 at Kansas City, Missouri]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 14	April 28	May 8
2 years in 10 later than--	April 3	April 17	April 25
5 years in 10 later than--	March 13	March 25	April 2
First freezing temperature in fall:			
1 year in 10 earlier than--	October 31	October 26	October 16
2 years in 10 earlier than--	November 6	October 30	October 21
5 years in 10 earlier than--	November 18	November 6	October 31

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-79 at Kansas City, Missouri]

Probability	Length of growing season if daily minimum temperature is--		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	220	201	185
8 years in 10	228	207	192
5 years in 10	244	220	206
2 years in 10	260	232	220
1 year in 10	268	239	227

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1B	Sibley silt loam, 2 to 5 percent slopes	21,030	5.4
1C	Sibley silt loam, 5 to 9 percent slopes	8,920	2.3
2C	Higginsville silt loam, 5 to 9 percent slopes	22,550	5.8
5B	Macksburg silt loam, 3 to 5 percent slopes	20,525	5.3
6B	Sharpsburg silt loam, 2 to 5 percent slopes	21,285	5.4
6C2	Sharpsburg silt loam, 5 to 9 percent slopes, eroded	10,745	2.8
8	Pits, quarries	1,570	0.4
10D	Snead-Rock outcrop complex, 5 to 14 percent slopes	14,290	3.7
10F	Snead-Rock outcrop complex, 14 to 30 percent slopes	20,070	5.1
11C	Greenton silty clay loam, 5 to 9 percent slopes	13,280	3.4
13B	Sampsel silty clay loam, 2 to 5 percent slopes	4,510	1.2
13C	Sampsel silty clay loam, 5 to 9 percent slopes	16,115	4.1
15B	Menfro silt loam, 2 to 5 percent slopes	9,120	2.3
15C2	Menfro silt loam, 5 to 9 percent slopes, eroded	9,730	2.5
16D3	Menfro silty clay loam, 9 to 14 percent slopes, severely eroded	6,285	1.6
17B	Polo silt loam, 2 to 5 percent slopes	3,290	0.8
17C2	Polo silt loam, 5 to 9 percent slopes, eroded	6,030	1.5
19B	Weller silt loam, 2 to 5 percent slopes	1,470	0.4
20C2	McGirk silt loam, 5 to 9 percent slopes, eroded	3,800	1.0
22C2	Oska silty clay loam, 5 to 9 percent slopes, eroded	9,830	2.5
30	Kennebec silt loam	17,740	4.5
31	Colo silty clay loam	5,475	1.4
33	Zook silty clay loam	4,715	1.2
36	Bremer silt loam	9,020	2.3
38	Wiota silt loam	830	0.2
47D	Mandeville silt loam, 5 to 14 percent slopes	2,890	0.7
54C	Knox silt loam, 5 to 9 percent slopes	9,475	2.4
54E	Knox silt loam, 14 to 20 percent slopes	3,700	0.9
54F	Knox silt loam, 20 to 30 percent slopes	1,470	0.4
55D3	Knox silty clay loam, 5 to 14 percent slopes, severely eroded	9,580	2.4
60B	Sibley-Urban land complex, 2 to 5 percent slopes	12,570	3.2
60C	Sibley-Urban land complex, 5 to 9 percent slopes	14,090	3.6
61C	Knox-Urban land complex, 5 to 9 percent slopes	5,470	1.4
61D	Knox-Urban land complex, 9 to 14 percent slopes	6,285	1.6
62B	Macksburg-Urban land complex, 2 to 5 percent slopes	1,470	0.4
63C	Higginsville-Urban land complex, 5 to 9 percent slopes	3,850	1.0
64C	Greenton-Urban land complex, 5 to 9 percent slopes	2,990	0.8
65F	Snead-Urban land complex, 9 to 30 percent slopes	7,705	2.0
68C	Urban land, upland, 5 to 9 percent slopes	4,255	1.1
68D	Urban land, upland, 9 to 14 percent slopes	525	0.1
69A	Urban land, bottom land, 0 to 3 percent slopes	6,285	1.6
73	Leta silty clay	3,295	0.8
82	Parkville silty clay	1,370	0.4
83	Haynie silt loam	9,935	2.6
87	Modale silt loam	1,370	0.4
88	Gilliam silty clay loam	2,990	0.8
89	Sarpy fine sand	325	0.1
90	Wabash silty clay	2,485	0.6
91A	Napier silt loam, 0 to 3 percent slopes	1,570	0.4
92	Cotter silt loam	870	0.2
100C	Urban land-Harvester complex, 2 to 9 percent slopes	7,420	1.9
102	Udifluvents, nearly level	1,875	0.5
103	Udorthents, nearly level	179	*
	Water, less than 40 acres	2,444	0.6
	Total land area	390,963	100.0
	Water, greater than 40 acres	3,456	---
	Total area	394,419	---

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
1B	Sibley silt loam, 2 to 5 percent slopes
1C	Sibley silt loam, 5 to 9 percent slopes
5B	Macksburg silt loam, 2 to 5 percent slopes
6B	Sharpsburg silt loam, 2 to 5 percent slopes
13B	Sampsel silty clay loam, 2 to 5 percent slopes (where drained)
15B	Menfro silt loam, 2 to 5 percent slopes
17B	Polo silt loam, 2 to 5 percent slopes
19B	Weller silt loam, 2 to 5 percent slopes
30	Kennebec silt loam
31	Colo silty clay loam (where drained)
33	Zook silty clay loam (where drained)
36	Bremer silt loam (where drained)
38	Wiota silt loam
73	Leta silty clay
82	Parkville silty clay
83	Haynie silt loam
87	Modale silt loam
88	Gilliam silty clay loam
90	Wabash silty clay (where drained)
91A	Napier silt loam, 0 to 3 percent slopes
92	Cotter silt loam

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield figure indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Grass-legume hay	Smooth bromegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
1B--------------- Sibley	IIe	115	45	95	48	4.8	10.0
1C--------------- Sibley	IIIe	108	39	85	40	4.5	9.6
2C--------------- Higginsville	IIIe	108	41	94	45	4.8	9.6
5B--------------- Macksburg	IIe	110	44	96	45	4.9	9.6
6B--------------- Sharpsburg	IIe	102	43	88	45	4.7	9.0
6C2-------------- Sharpsburg	IIIe	90	40	80	42	4.8	8.0
8**. Pits							
10D-------------- Snead-Rock outcrop	VIs	---	---	---	---	---	---
10F-------------- Snead-Rock outcrop	VIIs	---	---	---	---	---	---
11C-------------- Greenton	IIIe	85	31	72	34	3.7	7.0
13B-------------- Sampsel	IIe	86	33	74	35	3.7	7.6
13C-------------- Sampsel	IIIe	79	30	66	30	3.7	7.0
15B-------------- Menfro	IIe	92	35	82	38	4.0	8.0
15C2------------- Menfro	IIIe	76	29	74	33	3.5	7.4
16D3------------- Menfro	IVe	65	24	63	26	3.0	6.0
17B-------------- Polo	IIe	105	39	88	40	4.3	9.2
17C2------------- Polo	IIIe	88	30	70	32	3.7	7.6
19B-------------- Weller	IIIe	80	30	75	38	4.0	7.4
20C2------------- McGirk	IVe	58	20	50	24	2.7	5.4
22C2------------- Oska	IVe	56	26	66	30	2.7	5.2
30--------------- Kennebec	IIw	100	38	85	30	3.3	9.0

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Grass-legume hay	Smooth bromegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
31-------------- Colo	IIw	98	40	100	30	4.5	---
33-------------- Zook	IIw	85	36	73	32	3.5	---
36-------------- Bremer	IIw	96	36	83	42	4.0	---
38-------------- Wiota	I	110	42	96	45	4.6	9.6
47D------------- Mandeville	IVe	50	20	40	22	2.3	4.6
54C------------- Knox	IIIe	89	33	80	36	4.0	8.0
54E------------- Knox	IVe	71	25	60	31	3.2	6.4
54F------------- Knox	VIe	---	---	---	---	3.0	6.0
55D3------------ Knox	IVe	65	25	60	26	3.2	6.4
60B------------- Sibley-Urban land	---	---	---	---	---	---	---
60C------------- Sibley-Urban land	---	---	---	---	---	---	---
61C------------- Knox-Urban land	---	---	---	---	---	---	---
61D------------- Knox-Urban land	---	---	---	---	---	---	---
62B------------- Macksburg-Urban land	---	---	---	---	---	---	---
63C------------- Higginsville-Urban land	---	---	---	---	---	---	---
64C------------- Greenton-Urban land	---	---	---	---	---	---	---
65F------------- Snead-Urban land	---	---	---	---	---	---	---
68C**, 68D**, 69A**---------- Urban land	---	---	---	---	---	---	---
73-------------- Leta	IIw	88	32	75	35	3.8	7.4
82-------------- Parkville	IIw	96	38	88	42	4.0	8.0

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Grass-legume hay	Smooth bromegrass
		Bu	Bu	Bu	Bu	Tons	AUM*
83--------------- Haynie	I	96	36	88	40	3.6	8.6
87--------------- Modale	I	92	35	85	35	3.9	8.0
88--------------- Gilliam	IIw	115	45	108	45	4.5	10.0
89--------------- Sarpy	IVs	---	---	---	15	0.9	1.8
90--------------- Wabash	IIIw	65	32	65	30	2.0	3.5
91A-------------- Napier	I	107	41	94	45	4.5	6.5
92--------------- Cotter	I	110	45	96	45	4.6	9.6
100C------------- Urban land-Harvester	---	---	---	---	---	---	---
102-------------- Udifluvents	---	---	---	---	---	---	---
103-------------- Udorthents	---	---	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Trees to plant
10D*:								
Snead	4x	Slight	Moderate	Severe	Severe	Northern red oak	62	Eastern cottonwood.
Rock outcrop.								
10F*:								
Snead	4x	Moderate	Severe	Severe	Severe	White oak	55	Eastern cottonwood.
Rock outcrop.								
15B, 15C2, 16D3 Menfro	3o	Slight	Slight	Slight	Slight	White oak Northern red oak Black oak White ash Sugar maple	65 75 73 70 68	Shortleaf pine, green ash, black walnut, yellow-poplar, white oak, eastern white pine, sugar maple.
19B Weller	4o	Slight	Slight	Slight	Slight	White oak	55	Eastern white pine, red pine, black walnut, sugar maple.
20C2 McGirk	4w	Slight	Severe	Moderate	Moderate	White oak	55	White oak, pin oak, green ash, pecan, eastern cottonwood, sweetgum.
30 Kennebec	2o	Slight	Slight	Slight	Slight	Black walnut Bur oak Hackberry Green ash Eastern cottonwood	79 63 --- --- ---	Black walnut, bur oak, hackberry, green ash, eastern cottonwood, American sycamore.
36 Bremer	3w	Slight	Severe	Moderate	Moderate	Eastern cottonwood Silver maple	90 80	American sycamore, hackberry, green ash, eastern cottonwood, silver maple, northern white-cedar.
47D Mandeville	4o	Slight	Slight	Slight	Slight	White oak Black walnut Black oak Shagbark hickory White ash	60 --- --- --- ---	White oak, white ash, yellow-poplar, sweetgum.
54C Knox	3o	Slight	Slight	Slight	Slight	White oak	65	Eastern white pine, green ash, black walnut, yellow-poplar.
54E, 54F Knox	3r	Moderate	Moderate	Moderate	Slight	White oak	65	Eastern white pine, green ash, black walnut, yellow-poplar.
55D3 Knox	3o	Slight	Slight	Slight	Slight	White oak	65	Eastern white pine, green ash, black walnut, yellow-poplar.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
73----------------- Leta	3c	Slight	Moderate	Severe	Slight	Eastern cottonwood-- Black willow--------	90 ---	Sweetgum, pecan, eastern cottonwood, silver maple, green ash.
82----------------- Parkville	2c	Slight	Moderate	Severe	Slight	Eastern cottonwood-- Pin oak-------------	100 90	Eastern cottonwood, pin oak, pecan, sweetgum, American sycamore.
83----------------- Haynie	1o	Slight	Slight	Slight	Slight	Eastern cottonwood-- American sycamore--- Black walnut-------- Green ash-----------	110 110 --- ---	Black walnut, eastern cottonwood.
88----------------- Gilliam	2o	Slight	Slight	Slight	Slight	Pin oak------------- Eastern cottonwood--	86 96	Pin oak, eastern cottonwood, pecan.
89----------------- Sarpy	3s	Slight	Slight	Severe	Slight	Eastern cottonwood-- Silver maple--------	95 90	Eastern cottonwood, American sycamore, silver maple.
90----------------- Wabash	4w	Slight	Severe	Severe	Severe	Pin oak-------------	75	Pin oak, pecan, eastern cottonwood.
92----------------- Cotter	2o	Slight	Slight	Slight	Slight	Eastern cottonwood-- Yellow-poplar-------	100 90	Eastern cottonwood, yellow-poplar, black walnut.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
1B, 1C------------ Sibley	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Green ash, eastern redcedar, hackberry, bur oak, Russian-olive.	Eastern white pine, honeylocust, Austrian pine.	---
2C---------------- Higginsville	---	Amur honeysuckle, lilac, autumn-olive, Amur maple.	Eastern redcedar	Austrian pine, eastern white pine, honeylocust, hackberry, green ash, pin oak.	Eastern cottonwood.
5B---------------- Macksburg	---	Amur honeysuckle, lilac, autumn-olive, Amur maple.	Eastern redcedar	Austrian pine, eastern white pine, honeylocust, hackberry, green ash, pin oak.	Eastern cottonwood.
6B, 6C2----------- Sharpsburg	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Green ash, hackberry, bur oak, eastern redcedar, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
8*. Pits					
10D*, 10F*: Snead.					
Rock outcrop.					
11C--------------- Greenton	Lilac-------------	Amur honeysuckle, autumn-olive, Manchurian crabapple, Siberian peashrub.	Eastern redcedar, Austrian pine, hackberry, green ash, jack pine, Russian-olive.	Honeylocust-------	---
13B, 13C---------- Sampsel	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Norway spruce, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
15B, 15C2, 16D3--- Menfro	---	Lilac, Amur honeysuckle, autumn-olive, Amur maple.	Eastern redcedar, hackberry, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
17B, 17C2--------- Polo	---	Amur honeysuckle, autumn-olive, Amur maple, lilac.	Hackberry, green ash, bur oak, Russian-olive, eastern redcedar.	Austrian pine, honeylocust, eastern white pine.	---
19B--------------- Weller	Lilac-------------	Manchurian crabapple, Amur honeysuckle, Siberian peashrub, autumn-olive.	Eastern redcedar, Austrian pine, hackberry, green ash, jack pine, Russian-olive.	Honeylocust-------	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
20C2: McGirk	Lilac	Amur honeysuckle, autumn-olive, Manchurian crabapple, Siberian peashrub.	Hackberry, Russian-olive, Austrian pine, jack pine, eastern redcedar, green ash.	Honeylocust	---
22C2: Oska	Lilac	Siberian peashrub, autumn-olive, Manchurian crabapple, Amur honeysuckle.	Green ash, hackberry, Austrian pine, eastern redcedar, jack pine, Russian-olive.	Honeylocust	---
30: Kennebec	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Eastern redcedar	Austrian pine, hackberry, pin oak, green ash, honeylocust.	Eastern white pine, eastern cottonwood.
31: Colo	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, green ash, northern red oak, golden willow, honeylocust, silver maple, eastern cottonwood.	---
33: Zook	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Honeylocust, golden willow, green ash, northern red oak, silver maple, Austrian pine.	Eastern cottonwood.
36: Bremer	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
38: Wiota	---	Lilac, Amur honeysuckle, autumn-olive, Amur maple.	Eastern redcedar, hackberry, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
47D: Mandeville	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive	Eastern redcedar, Austrian pine, hackberry, green ash, Russian-olive, bur oak.	Honeylocust, Siberian elm.	---
54C, 54E, 54F, 55D3: Knox	---	Amur honeysuckle, autumn-olive, lilac, Amur maple.	Hackberry, eastern redcedar, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
60B*, 60C*: Sibley	---	Amur maple, Amur honeysuckle, lilac, autumn-olive.	Green ash, eastern redcedar, hackberry, bur oak, Russian-olive.	Eastern white pine, honeylocust, Austrian pine.	---
Urban land.					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
61C*, 61D*:					
Knox	---	Amur honeysuckle, autumn-olive, lilac, Amur maple.	Hackberry, eastern redcedar, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
Urban land.					
62B*:					
Macksburg	---	Amur honeysuckle, lilac, autumn-olive, Amur maple.	Eastern redcedar	Austrian pine, eastern white pine, honeylocust, hackberry, green ash, pin oak.	Eastern cottonwood.
Urban land.					
63C*:					
Higginsville	---	Amur honeysuckle, lilac, autumn-olive, Amur maple.	Eastern redcedar	Austrian pine, eastern white pine, honeylocust, hackberry, green ash, pin oak.	Eastern cottonwood.
Urban land.					
64C*:					
Greenton	Lilac	Amur honeysuckle, autumn-olive, Manchurian crabapple, Siberian peashrub.	Eastern redcedar, Austrian pine, hackberry, green ash, jack pine, Russian-olive.	Honeylocust	---
Urban land.					
65F*:					
Snead.					
Urban land.					
68C*, 68D*, 69A*. Urban land					
73 Leta	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, osageorange, Russian-olive, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
82 Parkville	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, Russian-olive, osageorange, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
83 Haynie	Blackhaw	Tatarian honeysuckle, Siberian peashrub.	Russian-olive, osageorange, eastern redcedar, Washington hawthorn.	Green ash, hackberry, honeylocust, bur oak.	Eastern cottonwood.
87 Modale	---	Tatarian honeysuckle, Siberian peashrub, lilac.	Ponderosa pine, Russian-olive, bur oak, eastern redcedar.	Golden willow, honeylocust, green ash, hackberry.	Eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
88----------------- Gilliam	Blackhaw------------	Tatarian honeysuckle, Siberian peashrub.	Osageorange, eastern redcedar, Russian-olive, Washington hawthorn.	Honeylocust, hackberry, bur oak, green ash.	Eastern cottonwood.
89----------------- Sarpy	Blackhaw------------	Tatarian honeysuckle, Siberian peashrub.	Washington hawthorn, Russian-olive, eastern redcedar, osageorange.	Hackberry, green ash, honeylocust, bur oak.	Eastern cottonwood.
90----------------- Wabash	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, green ash, northern red oak, golden willow, honeylocust, silver maple.	Eastern cottonwood.
91A---------------- Napier	---	Lilac, Amur honeysuckle, autumn-olive, Amur maple.	Bur oak, eastern redcedar, Russian-olive, hackberry, green ash.	Austrian pine, honeylocust, eastern white pine.	---
92----------------- Cotter	---	Autumn-olive, Amur maple, lilac, Amur honeysuckle.	Green ash, hackberry, bur oak, eastern redcedar, Russian-olive.	Eastern white pine, Austrian pine, honeylocust.	---
100C*: Urban land.					
Harvester----------	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern white-cedar, blue spruce, white fir.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
102*. Udifluvents					
103*. Udorthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1B--------------------Sibley	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
1C--------------------Sibley	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
2C--------------------Higginsville	Moderate: wetness.	Moderate: wetness.	Severe: slope.	Moderate: wetness.	Moderate: wetness.
5B--------------------Macksburg	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: slope, wetness, percs slowly.	Slight----------	Slight.
6B--------------------Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
6C2-------------------Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
8*. Pits					
10D*:					
Snead-----------------	Moderate: large stones, slope.	Moderate: large stones, slope.	Severe: large stones, slope, small stones.	Moderate: large stones.	Severe: large stones.
Rock outcrop.					
10F*:					
Snead-----------------	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: large stones, slope.
Rock outcrop.					
11C-------------------Greenton	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
13B-------------------Sampsel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
13C-------------------Sampsel	Severe: wetness.	Severe: wetness.	Severe: slope.	Severe: wetness.	Severe: wetness.
15B-------------------Menfro	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
15C2------------------Menfro	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
16D3------------------Menfro	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
17B-------------------Polo	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
17C2 Polo	Slight	Slight	Severe: slope.	Slight	Slight.
19B Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
20C2 McGirk	Severe: wetness.	Severe: wetness.	Severe: slope, wetness.	Severe: wetness, erodes easily.	Severe: wetness.
22C2 Oska	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight	Moderate: thin layer.
30 Kennebec	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
31 Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
33 Zook	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
36 Bremer	Severe: wetness, flooding.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
38 Wiota	Severe: flooding.	Slight	Slight	Slight	Slight.
47D Mandeville	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Severe: erodes easily.	Moderate: slope, thin layer.
54C Knox	Slight	Slight	Severe: slope.	Slight	Slight.
54E Knox	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
54F Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
55D3 Knox	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
60B*:					
Sibley	Slight	Slight	Moderate: slope.	Slight	Slight.
Urban land.					
60C*:					
Sibley	Slight	Slight	Severe: slope.	Slight	Slight.
Urban land.					
61C*:					
Knox	Slight	Slight	Severe: slope.	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
61C*: Urban land.					
61D*: Knox	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Urban land.					
62B*: Macksburg	Moderate: percs slowly, wetness.	Moderate: percs slowly, wetness.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
Urban land.					
63C*: Higginsville	Moderate: wetness.	Moderate: wetness.	Severe: slope.	Moderate: wetness.	Moderate: wetness.
Urban land.					
64C*: Greenton	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
Urban land.					
65F*: Snead	Severe: slope.	Severe: slope.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: large stones, slope.
Urban land.					
68C*, 68D*, 69A*. Urban land					
73 Leta	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
82 Parkville	Severe: flooding, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Severe: too clayey.	Severe: too clayey.
83 Haynie	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
87 Modale	Severe: flooding, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness, flooding.
88 Gilliam	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, flooding.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
89-------------------- Sarpy	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
90-------------------- Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
91A------------------- Napier	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
92-------------------- Cotter	Severe: flooding.	Slight----------	Slight----------	Slight----------	Slight.
100C*: Urban land.					
Harvester------------	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
102*. Udifluvents					
103*. Udorthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
1B----------------- Sibley	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
1C----------------- Sibley	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
2C----------------- Higginsville	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
5B----------------- Macksburg	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
6B----------------- Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
6C2---------------- Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8*. Pits										
10D*:										
Snead--------------	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										
10F*:										
Snead--------------	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										
11C---------------- Greenton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
13B, 13C----------- Sampsel	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
15B---------------- Menfro	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
15C2, 16D3--------- Menfro	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
17B---------------- Polo	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
17C2--------------- Polo	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
19B---------------- Weller	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
20C2--------------- McGirk	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
22C2--------------- Oska	Fair	Good	Good	---	---	Poor	Poor	Fair	---	Poor.
30----------------- Kennebec	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
31----------------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
33----------------- Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
36----------------- Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
38----------------- Wiota	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
47D---------------- Mandeville	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
54C---------------- Knox	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
54E---------------- Knox	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
54F---------------- Knox	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
55D3--------------- Knox	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
60B*:										
Sibley------------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Urban land.										
60C*:										
Sibley------------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Urban land.										
61C*, 61D*:										
Knox--------------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Urban land.										
62B*:										
Macksburg---------	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Urban land.										
63C*:										
Higginsville------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Urban land.										
64C*:										
Greenton----------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Urban land.										
65F*:										
Snead-------------	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Urban land.										

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
68C*, 68D*, 69A*. Urban land										
73----------------- Leta	Fair	Fair	Poor	Good	Good	Poor	Fair	Fair	Fair	Poor.
82----------------- Parkville	Poor	Fair	Fair	Good	Good	Poor	Fair	Fair	Good	Poor.
83----------------- Haynie	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
87----------------- Modale	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
88----------------- Gilliam	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
89----------------- Sarpy	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
90----------------- Wabash	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
91A---------------- Napier	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
92----------------- Cotter	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
100C*: Urban land.										
Harvester.										
102*. Udifluvents										
103*. Udorthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1B: Sibley	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
1C: Sibley	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
2C: Higginsville	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness.
5B: Macksburg	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
6B: Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
6C2: Sharpsburg	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
8*. Pits						
10D*:						
Snead	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Severe: large stones.
Rock outcrop.						
10F*:						
Snead	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.
Rock outcrop.						
11C: Greenton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
13B, 13C: Sampsel	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: low strength, frost action, wetness.	Severe: wetness.
15B: Menfro	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
15C2: Menfro	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
16D3: Menfro	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
17B: Polo	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
17C2: Polo	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
19B: Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
20C2: McGirk	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
22C2: Oska	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: thin layer.
30: Kennebec	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action, low strength.	Moderate: flooding.
31: Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
33: Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
36: Bremer	Severe: wetness.	Severe: wetness, shrink-swell, flooding.	Severe: wetness, shrink-swell, flooding.	Severe: wetness, shrink-swell, flooding.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
38: Wiota	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.
47D: Mandeville	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: low strength, wetness, slope.	Moderate: slope, thin layer.
54C: Knox	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
54E, 54F: Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
55D3: Knox	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
60B*:						
Sibley	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
Urban land.						

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
60C*:						
Sibley	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Urban land.						
61C*:						
Knox	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Urban land.						
61D*:						
Knox	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
Urban land.						
62B*:						
Macksburg	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.
Urban land.						
63C*:						
Higginsville	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness.
Urban land.						
64C*:						
Greenton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
Urban land.						
65F*:						
Snead	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.
Urban land.						
68C*, 68D*, 69A*. Urban land						
73 Leta	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.	Severe: too clayey.
82 Parkville	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Severe: too clayey.
83 Haynie	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
87----------------- Modale	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
88----------------- Gilliam	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
89----------------- Sarpy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
90----------------- Wabash	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.	Severe: wetness, too clayey.
91A---------------- Napier	Slight----------	Slight----------	Slight----------	Slight----------	Severe: low strength, frost action.	Slight.
92----------------- Cotter	Slight----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.
100C*: Urban land.						
Harvester---------	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
102*. Udifluvents						
103*. Udorthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1B------------------ Sibley	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
1C------------------ Sibley	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
2C------------------ Higginsville	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
5B------------------ Macksburg	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
6B------------------ Sharpsburg	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
6C2----------------- Sharpsburg	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
8*. Pits					
10D*:					
Snead--------------	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Rock outcrop.					
10F*:					
Snead--------------	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Rock outcrop.					
11C----------------- Greenton	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
13B----------------- Sampsel	Severe: wetness, percs slowly.	Moderate: depth to rock.	Severe: depth to rock, wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
13C----------------- Sampsel	Severe: wetness, percs slowly.	Severe: slope.	Severe: depth to rock, wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
15B----------------- Menfro	Slight-----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
15C2---------------- Menfro	Slight-----------	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
16D3----------------- Menfro	Moderate: slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: slope, too clayey.
17B----------------- Polo	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.
17C2----------------- Polo	Moderate: percs slowly.	Severe: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.
19B----------------- Weller	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, hard to pack.
20C2----------------- McGirk	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
22C2----------------- Oska	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
30------------------- Kennebec	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
31------------------- Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
33------------------- Zook	Severe: percs slowly, wetness, flooding.	Severe: flooding.	Severe: wetness, too clayey, flooding.	Severe: wetness, flooding.	Poor: too clayey, wetness, hard to pack.
36------------------- Bremer	Severe: percs slowly, flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness.
38------------------- Wiota	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
47D------------------ Mandeville	Severe: depth to rock, wetness.	Severe: depth to rock, slope, wetness.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
54C------------------ Knox	Slight-----------	Severe: slope.	Slight-----------	Slight-----------	Good.
54E, 54F------------- Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
55D3----------------- Knox	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
60B*:					
Sibley--------------	Slight-----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Urban land.					

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
60C*:					
Sibley	Slight	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Urban land.					
61C*:					
Knox	Slight	Severe: slope.	Slight	Slight	Good.
Urban land.					
61D*:					
Knox	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Urban land.					
62B*:					
Macksburg	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Urban land.					
63C*:					
Higginsville	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
Urban land.					
64C*:					
Greenton	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
Urban land.					
65F*:					
Snead	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Urban land.					
68C*, 68D*, 69A*. Urban land					
73 Leta	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
82 Parkville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
83 Haynie	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
87 Modale	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
88------------------ Gilliam	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
89------------------ Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
90------------------ Wabash	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
91A----------------- Napier	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Good.
92------------------ Cotter	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
100C*: Urban land.					
Harvester----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
102*. Udifluvents					
103*. Udorthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1B, 1C----------------- Sibley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
2C--------------------- Higginsville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
5B--------------------- Macksburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
6B, 6C2---------------- Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
8*. Pits				
10D*, 10F*:				
Snead-----------------	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
Rock outcrop.				
11C-------------------- Greenton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
13B, 13C--------------- Sampsel	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
15B, 15C2-------------- Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
16D3------------------- Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
17B, 17C2-------------- Polo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
19B-------------------- Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
20C2------------------- McGirk	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
22C2------------------- Oska	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
30--------------------- Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
31--------------------- Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
33: Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
36: Bremer	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
38: Wiota	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
47D: Mandeville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
54C: Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
54E: Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
54F: Knox	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
55D3: Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
60B*, 60C*:				
Sibley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
61C*:				
Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
61D*:				
Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Urban land.				
62B*:				
Macksburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Urban land.				
63C*:				
Higginsville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
64C*:				
Greenton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Urban land.				

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
65F*:				
Snead	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
Urban land.				
68C*, 68D*, 69A*. Urban land				
73 Leta	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
82 Parkville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
83 Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
87 Modale	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
88 Gilliam	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
89 Sarpy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
90 Wabash	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
91A Napier	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
92 Cotter	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
100C*: Urban land.				
Harvester	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
102*. Udifluvents				
103*. Udorthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1B, 1C: Sibley	Moderate: seepage, slope.	Slight	Deep to water	Slope	Favorable	Favorable.
2C: Higginsville	Moderate: seepage, slope.	Moderate: wetness.	Frost action, slope.	Wetness, slope, erodes easily.	Erodes easily, wetness.	Erodes easily.
5B: Macksburg	Moderate: seepage, slope.	Moderate: wetness.	Frost action, slope.	Wetness, slope.	Erodes easily, wetness.	Erodes easily.
6B, 6C2: Sharpsburg	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
8*. Pits						
10D*, 10F*:						
Snead	Severe: slope.	Severe: large stones.	Percs slowly, depth to rock, large stones.	Large stones, wetness.	Slope, large stones, depth to rock.	Large stones, slope.
Rock outcrop.						
11C: Greenton	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
13B, 13C: Sampsel	Moderate: depth to rock, slope.	Severe: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, wetness.
15B, 15C2: Menfro	Moderate: slope, seepage.	Slight	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
16D3: Menfro	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
17B, 17C2: Polo	Moderate: seepage, slope.	Slight	Deep to water	Slope	Favorable	Favorable.
19B: Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Percs slowly, erodes easily.
20C2: McGirk	Moderate: slope.	Severe: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
22C2: Oska	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily, percs slowly.	Erodes easily, depth to rock, percs slowly.
30: Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Deep to water	Flooding	Favorable	Favorable.
31: Colo	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Flooding, wetness.	Wetness	Wetness.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
33----------------- Zook	Slight----------	Severe: hard to pack, wetness.	Flooding, percs slowly, frost action.	Wetness, percs slowly.	Not needed-----	Not needed.
36----------------- Bremer	Slight----------	Severe: wetness, hard to pack.	Flooding, frost action.	Wetness, flooding.	Wetness---------	Wetness.
38----------------- Wiota	Moderate: seepage.	Slight----------	Deep to water	Favorable-------	Erodes easily	Erodes easily.
47D---------------- Mandeville	Severe: slope.	Severe: thin layer.	Depth to rock, slope.	Wetness, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
54C---------------- Knox	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope-----------	Erodes easily	Erodes easily.
54E, 54F, 55D3---- Knox	Severe: slope.	Severe: piping.	Deep to water	Slope-----------	Slope, erodes easily.	Slope, erodes easily.
60B*, 60C*:						
Sibley------------	Moderate: seepage, slope.	Slight----------	Deep to water	Slope-----------	Favorable-------	Favorable.
Urban land.						
61C*:						
Knox--------------	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope-----------	Erodes easily	Erodes easily.
Urban land.						
61D*:						
Knox--------------	Severe: slope.	Severe: piping.	Deep to water	Slope-----------	Slope, erodes easily.	Slope, erodes easily.
Urban land.						
62B*:						
Macksburg---------	Moderate: seepage, slope.	Moderate: wetness.	Frost action, slope.	Wetness, slope.	Erodes easily, wetness.	Erodes easily.
Urban land.						
63C*:						
Higginsville------	Moderate: seepage, slope.	Moderate: wetness.	Frost action, slope.	Wetness, slope, erodes easily.	Erodes easily, wetness.	Erodes easily.
Urban land.						
64C*:						
Greenton----------	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
Urban land.						
65F*:						
Snead-------------	Severe: depth to rock, slope.	Severe: large stones.	Percs slowly, depth to rock, large stones.	Large stones, wetness.	Slope, large stones, depth to rock.	Large stones, slope.
Urban land.						

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
68C*, 68D*, 69A*. Urban land						
73----------------- Leta	Moderate: seepage.	Severe: piping, wetness.	Percs slowly, flooding, frost action.	Wetness, slow intake, percs slowly.	Wetness---------	Wetness, percs slowly.
82----------------- Parkville	Moderate: seepage.	Severe: piping, wetness.	Percs slowly, flooding, cutbanks cave.	Wetness, slow intake, percs slowly.	Wetness---------	Wetness, percs slowly.
83----------------- Haynie	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
87----------------- Modale	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
88----------------- Gilliam	Moderate: seepage.	Severe: wetness, piping.	Flooding, frost action.	Wetness, flooding.	Wetness---------	Favorable.
89----------------- Sarpy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
90----------------- Wabash	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
91A---------------- Napier	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable-------	Erodes easily	Erodes easily.
92----------------- Cotter	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable-------	Erodes easily	Erodes easily.
100C*: Urban land.						
Harvester---------	Moderate: seepage, slope.	Slight---------	Deep to water	Slope-----------	Favorable-------	Favorable.
102*. Udifluvents						
103*. Udorthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1B, 1C------------ Sibley	0-15	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	30-40	10-20
	15-54	Silty clay loam	CL, CH, MH	A-7	0	100	100	95-100	90-100	40-55	20-35
	54-76	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
2C--------------- Higginsville	0-12	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-15
	12-18	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-25
	18-49	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	49-60	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-45	10-20
5B--------------- Macksburg	0-16	Silt loam, silty clay loam.	CL	A-7	0	100	100	100	95-100	35-50	15-25
	16-43	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	43-54	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
	54-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	20-30
6B--------------- Sharpsburg	0-13	Silt loam--------	CL	A-6	0	100	100	100	95-100	25-40	10-20
	13-55	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	55-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
6C2-------------- Sharpsburg	0-7	Silt loam--------	CL	A-6	0	100	100	100	95-100	25-40	10-20
	7-41	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	41-60	Silty clay loam, silt loam.	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
8*. Pits											
10D*, 10F*:											
Snead-----------	0-14	Flaggy silty clay loam.	CL, CH	A-7, A-6	10-40	70-90	60-85	55-80	50-75	35-55	20-35
	14-30	Silty clay, clay	CH, CL	A-7	0-10	90-100	90-100	90-100	80-100	45-60	25-40
	30-45	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop.											
11C--------------- Greenton	0-16	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	15-25
	16-46	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	95-100	50-70	35-45
	46-60	Silty clay, clay, channery silty clay.	CH	A-7	0-5	65-100	65-100	60-95	55-90	50-70	25-40
13B, 13C--------- Sampsel	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-99	35-50	15-25
	7-60	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	97-100	95-100	52-75	35-47
15B, 15C2-------- Menfro	0-6	Silt loam--------	CL	A-6	0	100	100	95-100	92-100	25-35	11-20
	6-49	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	49-60	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	92-100	25-35	5-15
16D3-------------- Menfro	0-6	Silty clay loam	CL	A-6	0	100	100	95-100	92-100	25-40	11-20
	6-40	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	40-66	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	92-100	25-35	5-15
17B--------------- Polo	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	14-19	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
	19-45	Silty clay, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	90-100	35-50	15-25
	45-67	Silty clay, shaly silty clay.	CH, CL	A-7	0	95-100	95-100	90-100	85-100	45-65	25-35

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
17C2------------- Polo	0-8	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	8-40	Silty clay, silty clay loam.	CL	A-7, A-6	0	100	100	95-100	90-100	35-50	15-25
	40-60	Silty clay, shaly silty clay.	CH, CL	A-7	0	95-100	95-100	90-100	85-100	45-65	25-35
19B-------------- Weller	0-21	Silt loam--------	ML, CL	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	21-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
	60-70	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	40-55	20-30
20C2------------- McGirk	0-6	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-40	5-15
	6-11	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	15-30
	11-66	Silty clay, silty clay loam.	CH, MH	A-7	0	100	100	95-100	90-100	50-75	25-40
22C2------------- Oska	0-7	Silty clay loam	ML, CL	A-6, A-7	0	100	100	96-100	90-100	38-50	12-22
	7-34	Silty clay, cherty silty clay, cherty silty clay loam.	CH, CL	A-7	0-5	85-100	65-100	60-100	55-100	45-60	20-35
	34	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
30--------------- Kennebec	0-19	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	25-45	10-20
	19-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	95-100	90-100	25-40	5-15
31--------------- Colo	0-6	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	6-36	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	36-63	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	100	100	95-100	80-100	40-55	15-30
33--------------- Zook	0-17	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	17-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
36--------------- Bremer	0-21	Silt loam, silty clay loam.	CH, CL	A-7	0	100	100	100	95-100	45-60	25-40
	21-44	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-65	20-35
	44-60	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-60	25-40
38--------------- Wiota	0-12	Silt loam--------	CL	A-6	0	100	100	100	90-95	30-40	10-20
	12-46	Silty clay loam	CL	A-7	0	100	100	95-100	90-95	40-50	15-25
	46-60	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	90-95	40-50	20-30
47D-------------- Mandeville	0-7	Silt loam--------	CL, CL-ML	A-4, A-6	0	90-100	90-100	90-100	85-95	25-35	5-15
	7-21	Silty clay loam, silt loam, loam.	CL	A-6	0-5	80-90	80-90	70-85	65-80	30-40	11-20
	21-23	Weathered bedrock	---	---	---	---	---	---	---	---	---
54C, 54E, 54F---- Knox	0-12	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	95-100	90-100	20-35	2-15
	12-61	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	61-71	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
55D3------------- Knox	0-3	Silty clay loam	CL	A-6	0	100	100	95-100	95-100	30-35	10-15
	3-29	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	29-60	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
60B*, 60C*:											
Sibley----------	0-15	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	30-40	10-20
	15-54	Silty clay loam	CL, CH, MH	A-7	0	100	100	95-100	90-100	40-55	20-35
	54-76	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
60B*, 60C*: Urban land.											
61C*: Knox------------	0-12	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	95-100	90-100	20-35	2-15
	12-61	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	61-71	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
Urban land.											
61D*: Knox------------	0-3	Silty clay loam	CL	A-6	0	100	100	95-100	95-100	30-35	10-15
	3-29	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	29-60	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
Urban land.											
62B*: Macksburg-------	0-16	Silt loam, silty clay loam.	CL	A-7	0	100	100	100	95-100	35-50	15-25
	16-43	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	43-54	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
	54-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	20-30
Urban land.											
63C*: Higginsville----	0-12	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-15
	12-18	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	15-25
	18-49	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	49-60	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-45	10-20
Urban land.											
64C*: Greenton--------	0-16	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	15-25
	16-46	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	95-100	50-70	35-45
	46-60	Silty clay, clay, channery silty clay.	CH	A-7	0-5	65-100	65-100	60-95	55-90	50-70	25-40
Urban land.											
65F*: Snead-----------	0-12	Flaggy silty clay loam.	CL, CH	A-7, A-6	10-40	70-90	60-85	55-80	50-75	35-55	20-35
	12-40	Silty clay, clay	CH, CL	A-7	0-10	90-100	90-100	90-100	80-100	45-60	25-40
	40-50	Weathered bedrock	---	---	---	---	---	---	---	---	---
Urban land.											
68C*, 68D*, 69A*. Urban land											
73--------------- Leta	0-15	Silty clay-------	CL, CH	A-7	0	100	100	95-100	95-100	45-65	30-45
	15-23	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-65	20-40
	23-60	Stratified silt loam to sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	80-100	51-95	20-35	5-15

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
82---------------- Parkville	0-17	Silty clay--------	CH	A-7	0	100	100	97-100	95-100	55-80	30-55
	17-33	Stratified very fine sand to silt loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-35	NP-15
	33-60	Stratified loamy fine sand to very fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	100	75-95	20-50	<20	NP-5
83---------------- Haynie	0-9	Silt loam---------	CL-ML, CL	A-4, A-6	0	100	100	85-100	70-100	25-40	5-15
	9-60	Silt loam, very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	85-100	25-35	5-15
87---------------- Modale	0-29	Silt loam---------	CL	A-4, A-6	0	100	100	95-100	70-90	25-40	8-18
	29-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	65-85	40-60
88---------------- Gilliam	0-15	Silty clay loam	CL	A-6, A-4	0	100	100	95-100	85-100	25-40	8-20
	15-26	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	90-100	80-95	25-40	8-20
	26-60	Stratified silty clay loam to loam.	CL-ML, CL	A-4, A-6	0	100	100	90-100	80-95	20-40	5-20
89---------------- Sarpy	0-6	Fine sand---------	SM, SP-SM, SP	A-2-4, A-3	0	100	100	60-80	2-15	---	NP
	6-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	60-80	2-35	---	NP
90---------------- Wabash	0-7	Silty clay--------	CH	A-7	0	100	100	100	95-100	50-75	30-50
	7-60	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
91A--------------- Napier	0-22	Silt loam---------	CL	A-4, A-6	0	100	100	95-100	95-100	25-40	8-20
	22-60	Silt loam---------	CL	A-4, A-6	0	100	100	95-100	95-100	25-40	8-20
92---------------- Cotter	0-13	Silt loam---------	CL	A-6	0	100	100	90-100	80-95	30-40	13-20
	13-42	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	80-90	30-40	14-22
	42-60	Loam, silt loam	CL	A-4, A-6	0	100	100	90-100	65-80	25-40	8-18
100C*: Urban land.											
Harvester--------	0-6	Silt loam---------	CL	A-4, A-6	0	100	100	95-100	90-100	25-35	9-19
	6-22	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	100	95-100	90-100	35-45	20-25
	22-60	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	98-100	92-98	90-95	35-45	20-25
102*. Udifluvents											
103*. Udorthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
1B, 1C------------ Sibley	0-15	20-30	1.20-1.50	0.6-2.0	0.19-0.21	5.6-7.8	Moderate-----	0.28	5	6	3-4
	15-54	28-38	1.30-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28			
	54-76	20-30	1.20-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.43			
2C---------------- Higginsville	0-12	20-27	1.30-1.50	0.6-2.0	0.21-0.24	5.6-7.3	Low----------	0.37	5	6	3-4
	12-18	27-35	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.37			
	18-49	27-35	1.40-1.50	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.37			
	49-60	25-30	1.50-1.60	0.6-2.0	0.18-0.22	5.1-6.5	Moderate-----	0.37			
5B---------------- Macksburg	0-16	25-34	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	7	3-4
	16-43	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43			
	43-54	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43			
	54-60	28-34	1.40-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43			
6B---------------- Sharpsburg	0-13	25-27	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	6	3-4
	13-55	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	55-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43			
6C2--------------- Sharpsburg	0-7	25-27	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	6	3-4
	7-41	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	41-60	25-32	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43			
8*. Pits											
10D*, 10F*:											
Snead------------	0-14	20-40	1.30-1.40	0.2-0.6	0.12-0.16	6.1-7.3	Moderate-----	0.28	3	6	2-4
	14-30	40-60	1.25-1.35	0.06-0.2	0.12-0.14	6.6-8.4	High---------	0.32			
	30-45	---	---	---	---	---	-------------	----			
Rock outcrop.											
11C--------------- Greenton	0-16	27-40	1.30-1.45	0.2-0.6	0.12-0.18	5.6-6.5	Moderate-----	0.37	2	6	1-3
	16-46	35-50	1.35-1.50	0.06-0.2	0.11-0.15	5.6-7.3	High---------	0.37			
	46-60	40-50	1.35-1.50	0.06-0.2	0.08-0.12	6.6-7.8	High---------	0.37			
13B, 13C---------- Sampsel	0-7	25-35	1.30-1.50	0.2-0.6	0.21-0.24	5.6-7.3	Moderate-----	0.37	3	4	3-4
	7-60	35-60	1.40-1.60	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.37			
15B, 15C2--------- Menfro	0-6	18-27	1.25-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	0.37	5	6	.5-2
	6-49	27-35	1.35-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37			
	49-60	8-20	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.37			
16D3-------------- Menfro	0-6	27-30	1.30-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37	4	6	.5-1
	6-40	27-35	1.35-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.37			
	40-66	8-20	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.37			
17B--------------- Polo	0-14	22-30	1.10-1.40	0.6-2.0	0.22-0.24	5.6-6.5	Low----------	0.32	5	6	2-5
	14-19	27-35	1.20-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.32			
	19-45	34-42	1.20-1.40	0.6-2.0	0.12-0.18	5.1-6.5	Moderate-----	0.32			
	45-67	40-50	1.40-1.60	0.6-2.0	0.10-0.12	5.1-6.5	High---------	0.32			
17C2-------------- Polo	0-8	22-30	1.10-1.40	0.6-2.0	0.22-0.24	5.6-6.5	Low----------	0.32	5	6	2-5
	8-40	34-42	1.20-1.40	0.6-2.0	0.12-0.18	5.1-6.5	Moderate-----	0.32			
	40-60	40-50	1.40-1.60	0.6-2.0	0.10-0.12	5.1-6.5	High---------	0.32			
19B--------------- Weller	0-21	16-27	1.35-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.43	3	6	1-2
	21-60	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.5	High---------	0.43			
	60-70	28-40	1.40-1.55	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
20C2------------- McGirk	0-6	15-27	1.30-1.45	0.6-2.0	0.22-0.24	5.1-6.5	Low-----------	0.43	3	6	1-2
	6-11	27-40	1.30-1.40	0.2-0.6	0.18-0.20	4.5-5.5	Moderate-----	0.43			
	11-66	35-50	1.25-1.35	0.06-0.2	0.10-0.18	4.5-6.0	High---------	0.32			
22C2------------- Oska	0-7	20-40	1.30-1.40	0.2-0.6	0.18-0.20	5.6-6.5	Moderate-----	0.37	3	7	1-3
	7-34	35-50	1.35-1.45	0.06-0.2	0.14-0.18	5.6-7.8	High---------	0.37			
	34	---	---	---	---	---	-------------	----			
30--------------- Kennebec	0-19	22-30	1.25-1.35	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.32	5	6	5-6
	19-60	24-28	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.43			
31--------------- Colo	0-6	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
	6-36	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	High---------	0.28			
	36-63	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.28			
33--------------- Zook	0-17	32-38	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High---------	0.28	5	7	5-7
	17-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28			
36--------------- Bremer	0-21	25-32	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7	5-7
	21-44	35-42	1.30-1.40	0.2-0.6	0.15-0.17	5.6-6.5	High---------	0.28			
	44-60	32-38	1.40-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.28			
38--------------- Wiota	0-12	24-32	1.30-1.35	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.32	5	6	3-4
	12-46	30-36	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	46-60	28-34	1.40-1.45	0.6-2.0	0.18-0.20	6.1-6.5	Moderate-----	0.43			
47D-------------- Mandeville	0-7	15-27	1.35-1.45	0.6-2.0	0.22-0.24	5.1-6.5	Low-----------	0.37	4	6	1-2
	7-21	20-32	1.30-1.40	0.6-2.0	0.14-0.20	4.5-6.0	Low-----------	0.37			
	21-23	---	---	---	---	---	-------------	----			
54C, 54E, 54F---- Knox	0-12	18-27	1.20-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5	6	1-3
	12-61	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	61-71	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.43			
55D3------------- Knox	0-3	27-30	1.20-1.30	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.32	5	6	1-3
	3-29	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	29-60	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.43			
60B*, 60C*: Sibley-----------	0-15	20-30	1.20-1.50	0.6-2.0	0.19-0.21	5.6-7.8	Moderate-----	0.28	5	6	3-4
	15-54	28-38	1.30-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28			
	54-76	20-30	1.20-1.50	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.43			
Urban land.											
61C*: Knox------------	0-12	18-27	1.20-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.32	5	6	1-3
	12-61	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	61-71	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.43			
Urban land.											
61D*: Knox------------	0-3	27-30	1.20-1.30	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.32	5	6	1-3
	3-29	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	29-60	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.43			
Urban land.											
62B*: Macksburg--------	0-16	25-34	1.30-1.35	0.6-2.0	0.21-0.23	5.1-6.5	Moderate-----	0.32	5	7	3-4
	16-43	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	High---------	0.43			
	43-54	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43			
	54-60	28-34	1.40-1.45	0.6-2.0	0.18-0.20	5.6-6.5	Moderate-----	0.43			
Urban land.											

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
63C*:											
Higginsville----	0-12	20-27	1.30-1.50	0.6-2.0	0.21-0.24	5.6-7.3	Low----------	0.37	5	6	3-4
	12-18	27-35	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.5	Moderate------	0.37			
	18-49	27-35	1.40-1.50	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.37			
	49-60	25-30	1.50-1.60	0.6-2.0	0.18-0.22	5.1-6.5	Moderate-----	0.37			
Urban land.											
64C*:											
Greenton---------	0-16	27-40	1.30-1.45	0.2-0.6	0.12-0.18	5.6-6.5	Moderate-----	0.37	2	6	1-3
	16-46	35-50	1.35-1.50	0.06-0.2	0.11-0.15	5.6-7.3	High---------	0.37			
	46-60	40-50	1.35-1.50	0.06-0.2	0.08-0.12	6.6-7.8	High---------	0.37			
Urban land.											
65F*:											
Snead-----------	0-12	20-40	1.30-1.40	0.2-0.6	0.12-0.16	6.1-7.3	Moderate-----	0.28	3	6	2-4
	12-40	40-60	1.25-1.35	0.06-0.2	0.12-0.14	6.6-8.4	High---------	0.32			
	40-50	---	---	---	---	---	------------	----			
Urban land.											
68C*, 68D*, 69A*. Urban land											
73--------------- Leta	0-15	40-48	1.30-1.50	0.06-0.2	0.12-0.14	6.6-7.8	High---------	0.28	5	4	2-4
	15-23	35-48	1.30-1.50	0.06-0.2	0.11-0.19	7.4-7.8	High---------	0.28			
	23-60	10-27	1.30-1.50	0.6-2.0	0.14-0.22	7.4-8.4	Low----------	0.28			
82--------------- Parkville	0-17	40-70	1.30-1.50	<0.06	0.11-0.13	6.6-8.4	High---------	0.28	5	4	1-3
	17-33	4-25	1.40-1.60	0.6-2.0	0.18-0.22	7.4-8.4	Low----------	0.28			
	33-60	4-25	1.40-1.60	2.0-6.0	0.08-0.18	7.4-8.4	Low----------	0.28			
83--------------- Haynie	0-9	15-25	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	Low----------	0.37	5	4L	1-3
	9-60	15-18	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	Low----------	0.37			
87--------------- Modale	0-29	12-18	1.20-1.30	0.6-2.0	0.21-0.23	7.4-8.4	Moderate-----	0.37	5	4L	1-3
	29-60	50-60	1.35-1.45	<0.2	0.11-0.13	7.4-8.4	High---------	0.28			
88--------------- Gilliam	0-15	15-35	1.25-1.40	0.6-2.0	0.20-0.24	6.6-8.4	Moderate-----	0.28	5	4L	2-4
	15-26	15-35	1.30-1.45	0.6-2.0	0.17-0.22	7.4-8.4	Moderate-----	0.28			
	26-60	12-35	1.30-1.45	0.6-2.0	0.17-0.22	7.4-8.4	Moderate-----	0.28			
89--------------- Sarpy	0-6	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	Low----------	0.15	5	1	<1
	6-60	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	Low----------	0.15			
90--------------- Wabash	0-7	40-46	1.25-1.45	<0.06	0.12-0.14	5.6-7.3	Very high----	0.28	5	4	2-4
	7-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.6-7.8	Very high----	0.28			
91A-------------- Napier	0-22	20-27	1.20-1.25	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	5	6	3-4
	22-60	20-27	1.25-1.30	0.6-2.0	0.20-0.22	6.1-8.4	Low----------	0.43			
92--------------- Cotter	0-13	18-32	1.35-1.45	0.6-2.0	0.23-0.26	5.6-7.8	Moderate-----	0.32	5	7	3-4
	13-42	25-35	1.25-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.43			
	42-60	18-27	1.30-1.45	0.6-2.0	0.20-0.22	5.1-7.3	Low----------	0.43			
100C*: Urban land.											
Harvester--------	0-6	18-25	1.40-1.60	0.2-0.6	0.10-0.20	5.6-7.3	Low----------	0.32	5	6	.5-2
	6-22	18-35	1.35-1.60	0.2-0.6	0.10-0.20	5.6-7.3	Moderate-----	0.32			
	22-60	18-35	1.35-1.50	0.6-2.0	0.18-0.24	5.6-7.3	Moderate-----	0.32			
102*. Udifluvents											

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
103*. Udorthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the t
< means less than; > means more than. Absence of an entry indicates that the feature is not a concern or th
estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	R
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Un
					Ft			In			
1B, 1C------------ Sibley	B	None---------	---	---	>6.0	---	---	>60	---	High------	Lo
2C---------------- Higginsville	C	None---------	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	High------	Mo
5B---------------- Macksburg	B	None---------	---	---	2.0-4.0	Apparent	Apr-Jul	>60	---	High------	Hi
6B, 6C2----------- Sharpsburg	B	None---------	---	---	>6.0	---	---	>60	---	High------	Mo
8*. Pits											
10D*, 10F*: Snead------------	D	None---------	---	---	2.0-3.0	Perched	Nov-Mar	20-40	Soft	Moderate	Hi
Rock outcrop.											
11C--------------- Greenton	C	None---------	---	---	1.0-3.0	Perched	Nov-Apr	>60	---	Moderate	Hi
13B, 13C---------- Sampsel	D	None---------	---	---	0-1.5	Perched	Nov-Apr	40-70	Soft	High------	Hi
15B, 15C2, 16D3--- Menfro	B	None---------	---	---	>6.0	---	---	>60	---	High------	Lo
17B, 17C2--------- Polo	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Mo
19B--------------- Weller	C	None---------	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High------	Hi
20C2-------------- McGirk	C	None---------	---	---	0.5-2.0	Perched	Nov-May	>60	---	High------	Hi
22C2-------------- Oska	C	None---------	---	---	>6.0	---	---	20-40	Hard	Moderate	Mo
30---------------- Kennebec	B	Occasional	Brief-----	Nov-Jun	3.0-5.0	Apparent	Nov-Jul	>60	---	High------	Mo
31---------------- Colo	B/D	Occasional	Very brief to long.	Nov-Jun	1.0-3.0	Apparent	Nov-Jul	>60	---	High------	Hi
33---------------- Zook	C/D	Occasional	Brief to long.	Nov-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High------	Hi

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	R
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Unc
					Ft			In			
36------------------ Bremer	C	Occasional	Very brief	Nov-Jun	1.0-2.0	Apparent	Nov-Jul	>60	---	High------	Mo
38------------------ Wiota	B	Rare---------	---	---	>6.0	---	---	>60	---	High------	Mo
47D----------------- Mandeville	B	None---------	---	---	2.0-3.0	Perched	Nov-Apr	20-40	Soft	Moderate	Lo
54C, 54E, 54F, 55D3-------------- Knox	B	None---------	---	---	>6.0	---	---	>60	---	High------	Lo
60B*, 60C*: Sibley------------	B	None---------	---	---	>6.0	---	---	>60	---	High------	Lo
Urban land.											
61C*, 61D*: Knox--------------	B	None---------	---	---	>6.0	---	---	>60	---	High------	Lo
Urban land.											
62B*: Macksburg---------	B	None---------	---	---	2.0-4.0	Apparent	Apr-Jul	>60	---	High------	Hi
Urban land.											
63C*: Higginsville------	C	None---------	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	High------	Mo
Urban land.											
64C*: Greenton----------	C	None---------	---	---	1.0-3.0	Perched	Nov-Apr	>60	---	Moderate	Hi
Urban land.											
65F*: Snead-------------	D	None---------	---	---	2.0-3.0	Perched	Nov-Mar	20-40	Soft	Moderate	Hi
Urban land.											
68C*, 68D*, 69A*. Urban land											
73------------------ Leta	C	Occasional	Brief------	Mar-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High------	Hi
82------------------ Parkville	C	Occasional	Brief------	Nov-Jun	1.0-2.0	Apparent	Nov-Apr	>60	---	Moderate	Hi
83------------------ Haynie	B	Occasional	Very brief	Nov-Jun	>6.0	---	---	>60	---	High------	Lo

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	U
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		
					Ft			In			
87-----------------Modale	C	Occasional	Brief-----	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High-----	H
88-----------------Gilliam	C	Occasional	Brief-----	Mar-Jun	1.5-3.0	Apparent	Nov-Jun	>60	---	High-----	H
89-----------------Sarpy	A	Occasional	Brief to long.	Nov-Jun	>6.0	---	---	>60	---	Low------	L
90-----------------Wabash	D	Occasional	Brief to long.	Nov-May	0-1.0	Apparent	Nov-May	>60	---	Moderate	H
91A----------------Napier	B	None--------	---	---	>6.0	---	---	>60	---	High-----	L
92-----------------Cotter	B	Rare--------	---	---	>6.0	---	---	>60	---	High-----	M
100C*: Urban land.											
Harvester---------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	L
102*. Udifluvents											
103*. Udorthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bremer	Fine, montmorillonitic, mesic Typic Argiaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Cotter	Fine-silty, mixed, mesic Typic Argiudolls
Gilliam	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Greenton	Fine, montmorillonitic, mesic Aquic Argiudolls
Harvester	Fine-silty, mixed, nonacid, mesic Typic Udorthents
Haynie	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Higginsville	Fine-silty, mixed, mesic Aquic Argiudolls
Kennebec	Fine-silty, mixed, mesic Cumulic Hapludolls
Knox	Fine-silty, mixed, mesic Mollic Hapludalfs
Leta	Clayey over loamy, montmorillonitic, mesic Fluvaquentic Hapludolls
Macksburg	Fine, montmorillonitic, mesic Aquic Argiudolls
Mandeville	Fine-loamy, mixed, mesic Typic Hapludalfs
McGirk	Fine, montmorillonitic, mesic, sloping Typic Ochraqualfs
Menfro	Fine-silty, mixed, mesic Typic Hapludalfs
Modale	Coarse-silty over clayey, mixed (calcareous), mesic Aquic Udifluvents
Napier	Fine-silty, mixed, mesic Cumulic Hapludolls
*Oska	Fine, montmorillonitic, mesic Typic Argiudolls
Parkville	Clayey over loamy, montmorillonitic, mesic Fluvaquentic Hapludolls
Polo	Fine, montmorillonitic, mesic Typic Argiudolls
Sampsel	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Sarpy	Mixed, mesic Typic Udipsamments
Sharpsburg	Fine, montmorillonitic, mesic Typic Argiudolls
Sibley	Fine-silty, mixed, mesic Typic Argiudolls
Snead	Fine, mixed, mesic Aquic Hapludolls
Udifluvents	Fine-loamy, mixed, mesic Typic Udifluvents
Udorthents	Fine-loamy, mixed, mesic Typic Udorthents
Wabash	Fine, montmorillonitic, mesic Vertic Haplaquolls
Weller	Fine, montmorillonitic, mesic Aquic Hapludalfs
Wiota	Fine-silty, mixed, mesic Typic Argiudolls
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

* The soil is a taxadjunct to the series. See the section "Soil Series and Their Morphology" for a description of those characteristics of the soil that are outside the range of the series.

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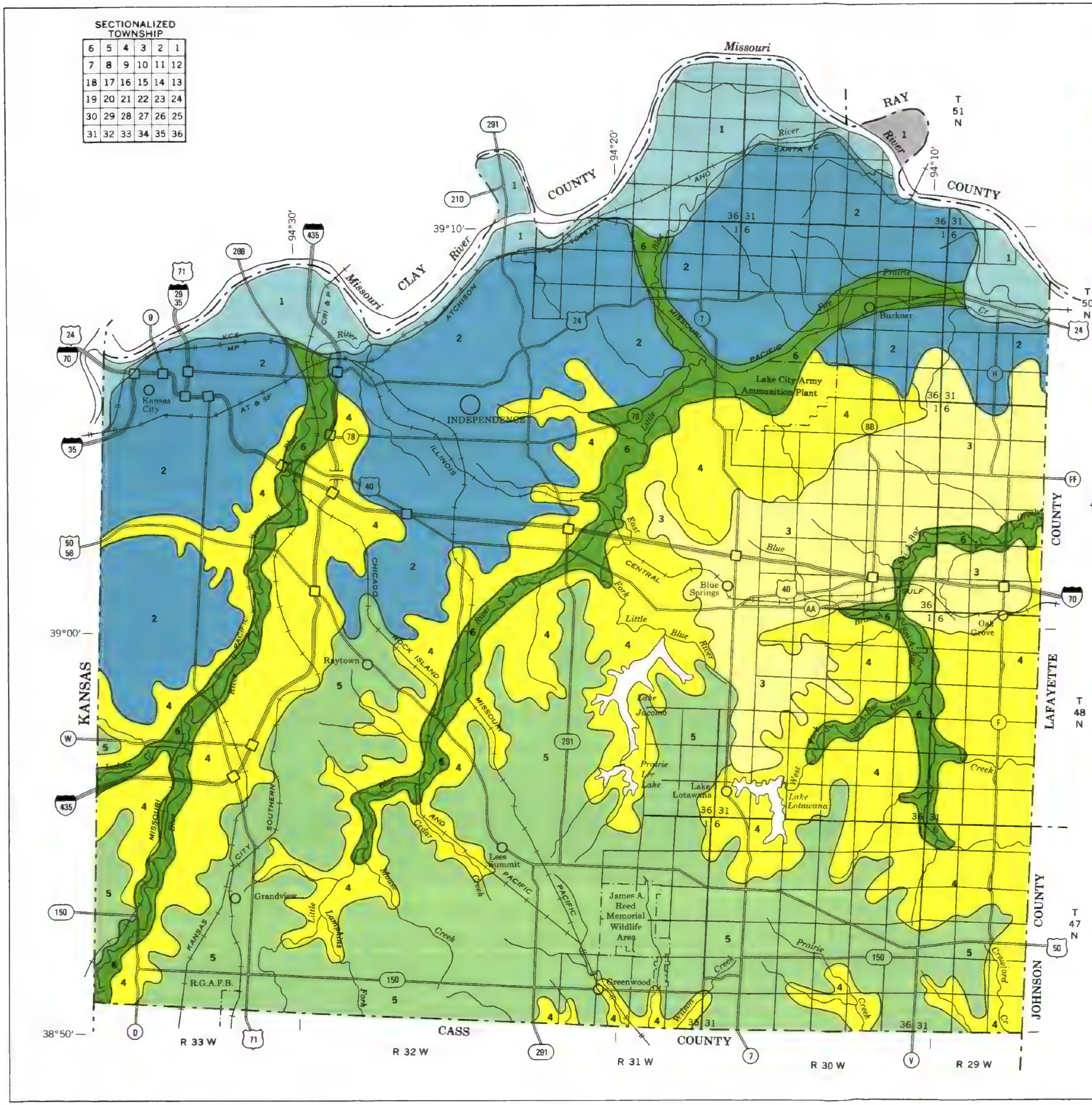


SOIL ASSOCIATIONS

1 **HAYNIE-URBAN LAND-LETA association:** Urban land and deep, nearly level, moderately well drained and somewhat poorly drained soils that formed in alluvium; on the Missouri River flood plain

2 **KNOX-SIBLEY-URBAN LAND association:** Urban land and deep, gently sloping to steep, well drained soils that formed in loess; on uplands

3 **HIGGINSVILLE-SIBLEY-SHARPSBURG association:** Deep, gently sloping and moderately sloping, somewhat poorly drained to well drained soils that formed in loess; on uplands

4 **SNEAD-MENFRO-OSKA association:** Moderately deep and deep, gently sloping to steep, well drained and moderately well drained soils that formed in loess or residuum from shale and limestone; on uplands

5 **MACKSBURG-SHARPSBURG-SAMPSEL association:** Deep, gently sloping and moderately sloping, moderately well drained to poorly drained soils that formed in loess or residuum from shale and limestone; on uplands

6 **KENNEBEC-COLO-BREMER association:** Deep, nearly level, moderately well drained and poorly drained soils that formed in alluvium; on flood plains and terraces

Compiled 1983

N

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

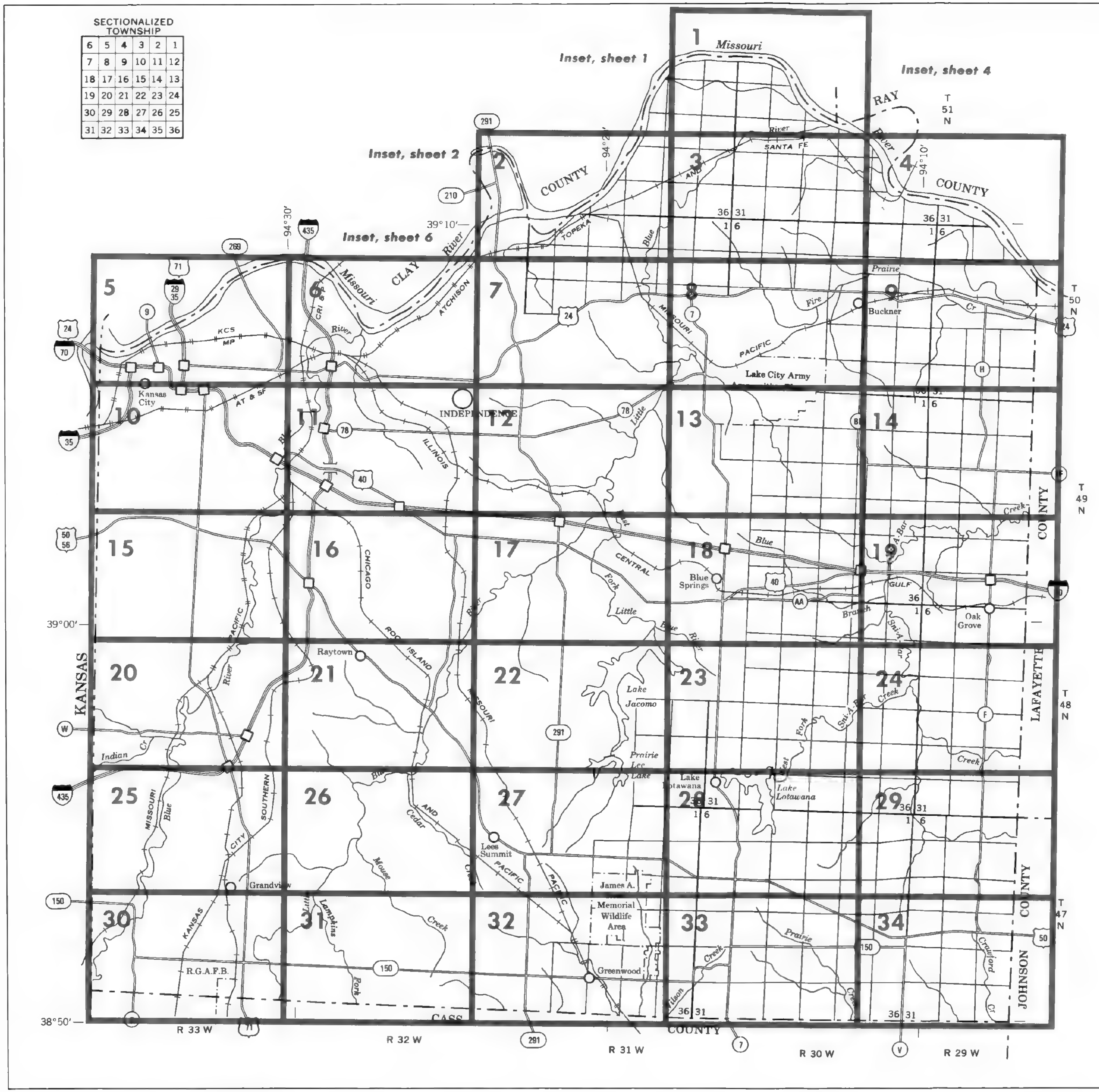
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MISSOURI AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
JACKSON COUNTY, MISSOURI

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km



INDEX TO MAP SHEETS

JACKSON COUNTY, MISSOURI

Scale 1:190,080

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is eroded and 3 that it is severely eroded.

SYMBOL	NAME
1B	Sibley silt loam, 2 to 5 percent slopes
1C	Sibley silt loam, 5 to 9 percent slopes
2C	Higginsville silt loam, 5 to 9 percent slopes
5B	Macksburg silt loam, 2 to 5 percent slopes
6B	Sharpsburg silt loam, 2 to 5 percent slopes
6C2	Sharpsburg silt loam, 5 to 9 percent slopes, eroded
8	Pits, quarries
10D	Snead-Rock outcrop complex, 5 to 14 percent slopes
10F	Snead-Rock outcrop complex, 14 to 30 percent slopes
11C	Greenton silty clay loam, 5 to 9 percent slopes
13B	Sampsel silty clay loam, 2 to 5 percent slopes
13C	Sampsel silty clay loam, 5 to 9 percent slopes
15B	Menfro silt loam, 2 to 5 percent slopes
15C2	Menfro silt loam, 5 to 9 percent slopes, eroded
16D3	Menfro silty clay loam, 9 to 14 percent slopes, severely eroded
17B	Polo silt loam, 2 to 5 percent slopes
17C2	Polo silt loam, 5 to 9 percent slopes, eroded
19B	Weller silt loam, 2 to 5 percent slopes
20C2	McGirk silt loam, 5 to 9 percent slopes, eroded
22C2	Oska silty clay loam, 5 to 9 percent slopes, eroded
30	Kennebec silt loam
31	Colo silty clay loam
33	Zook silty clay loam
36	Bremer silt loam
38	Wiota silt loam
47D	Mandeville silt loam, 5 to 14 percent slopes
54C	Knox silt loam, 5 to 9 percent slopes
54E	Knox silt loam, 14 to 20 percent slopes
54F	Knox silt loam, 20 to 30 percent slopes
55D3	Knox silty clay loam, 5 to 14 percent slopes, severely eroded
60B	Sibley-Urban land complex, 2 to 5 percent slopes
60C	Sibley-Urban land complex, 5 to 9 percent slopes
61C	Knox-Urban land complex, 5 to 9 percent slopes
61D	Knox-Urban land complex, 9 to 14 percent slopes
62B	Macksburg-Urban land complex, 2 to 5 percent slopes
63C	Higginsville-Urban land complex, 5 to 9 percent slopes
64C	Greenton Urban land complex, 5 to 9 percent slopes
65F	Snead-Urban land complex, 9 to 30 percent slopes
68C	Urban land, upland, 5 to 9 percent slopes
68D	Urban land, upland, 9 to 14 percent slopes
69A	Urban land, bottom land, 0 to 3 percent slopes
73	Leta silty clay
82	Parkville silty clay
83	Haynie silt loam
87	Modale silt loam
88	Gilliam silty clay loam
89	Sarpy fine sand
90	Wabash silty clay
91A	Napier silt loam, 0 to 3 percent slopes
92	Cotter silt loam
100C	Urban land-Harvester complex, 2 to 9 percent slopes
102	Udifluvents, nearly level
103	Udorthents, nearly level

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES
- State
- County
- Reservation (air force base)
- Neatline

AD HOC BOUNDARY
- Small airport or cemetery

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections)

ROAD EMBLEMS & DESIGNATIONS
- Interstate — 35
- Federal — 61
- State — 94
- County — V

RAILROAD

LEVEES
- Without road

DAMS
- Large (to scale)
- Medium or small — water, w

WATER FEATURES

DRAINAGE
- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Ditches
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS
- Perennial — water, w

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 11C, 60B

① N

Scale 1:24000

2 Miles | 1 | 0 | ½ | ¼ | ¾
10000 Feet | 5000 | 0
1000 | 2000 | 3000 | 4000 | 5000

JACKSON COUNTY, MISSOURI NO. 1

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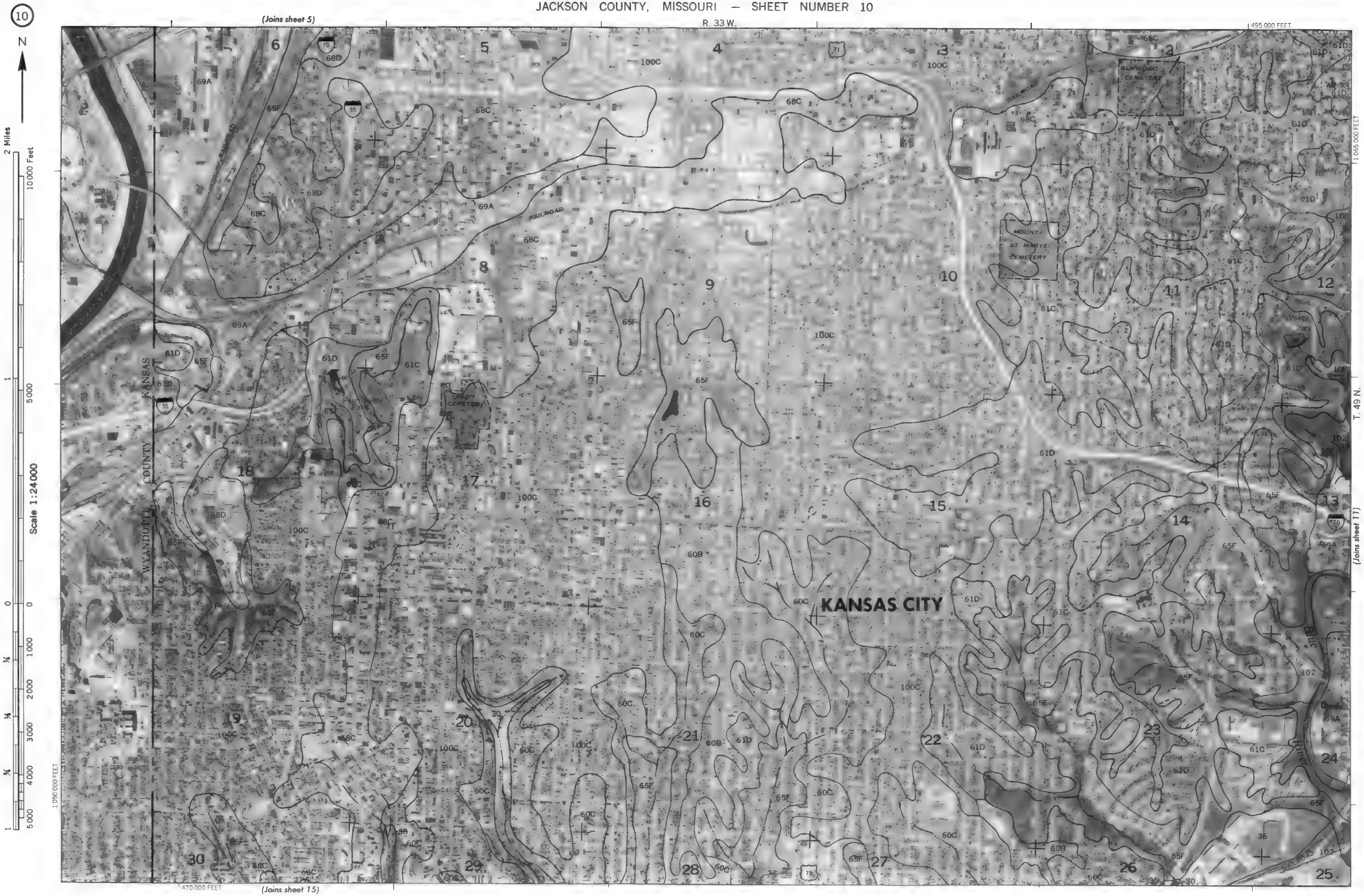

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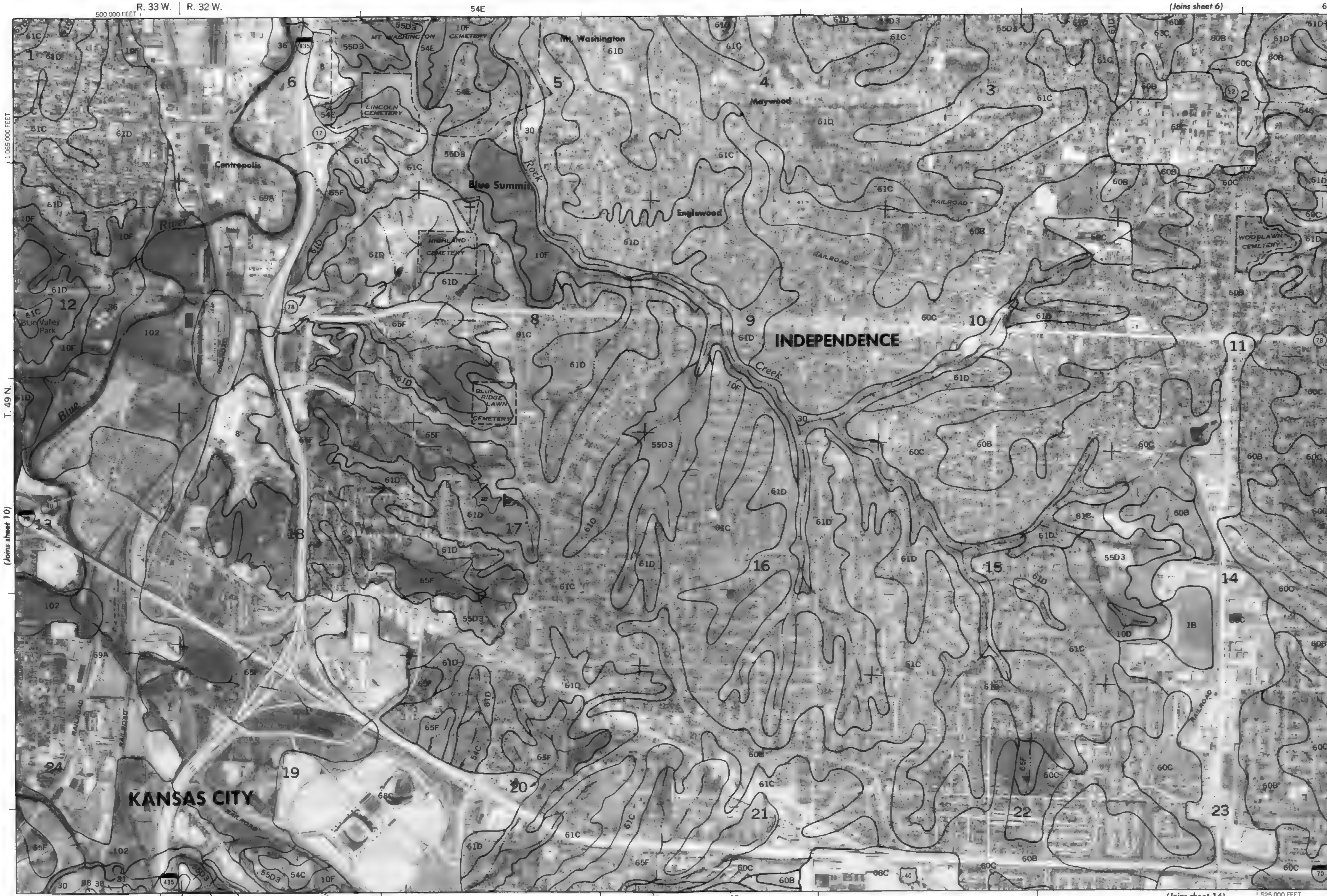
JACKSON COUNTY, MISSOURI NO. 10

(11)



N

Scale 1:24 000

0 ¼ ½ ¾ 1 2 Miles

0 1000 2000 3000 4000 5000 10000 Feet

JACKSON COUNTY, MISSOURI NO. 11

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JACKSON COUNTY, MISSOURI — SHEET NUMBER 12

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JACKSON COUNTY, MISSOURI NO. 12

JACKSON COUNTY, MISSOURI — SHEET NUMBER 13

JACKSON COUNTY, MISSOURI, NO. 13

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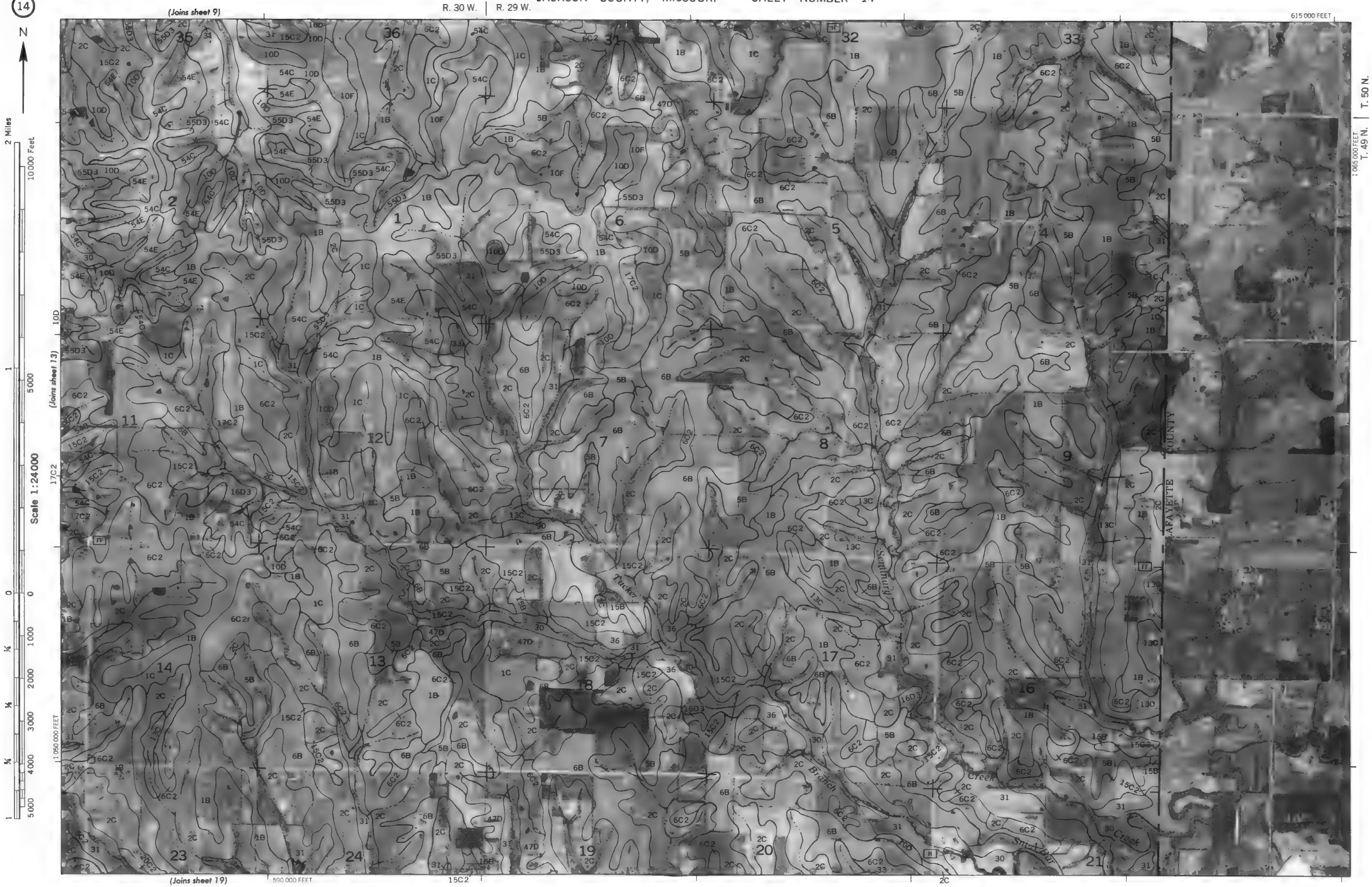

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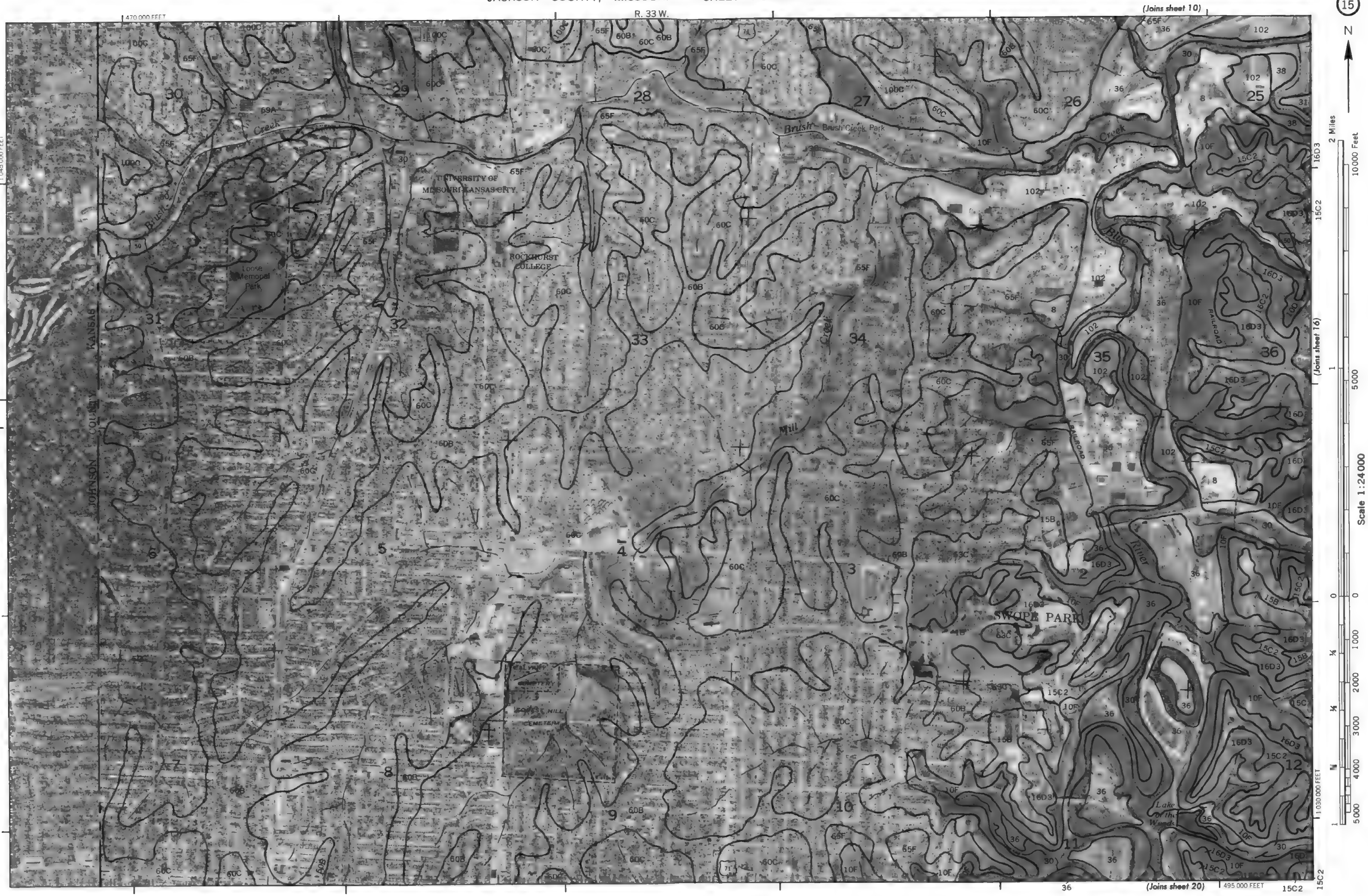

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JACKSON COUNTY, MISSOURI — SHEET NUMBER 16

16

R. 33 W. | R. 32 W.

(Joins sheet 11)

N

Scale 1:24000

2 Miles

10000 Feet

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JACKSON COUNTY, MISSOURI NO. 16

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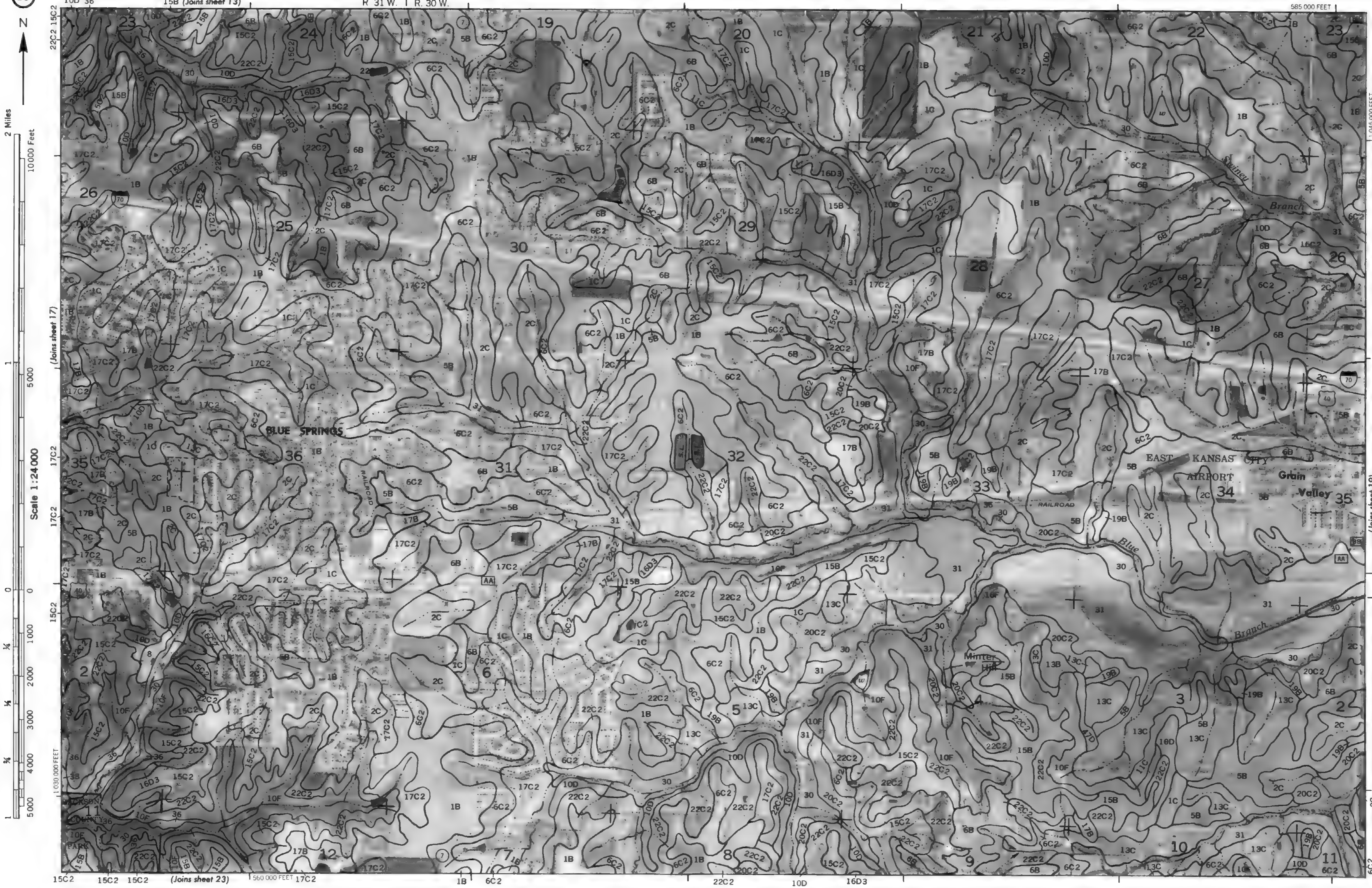
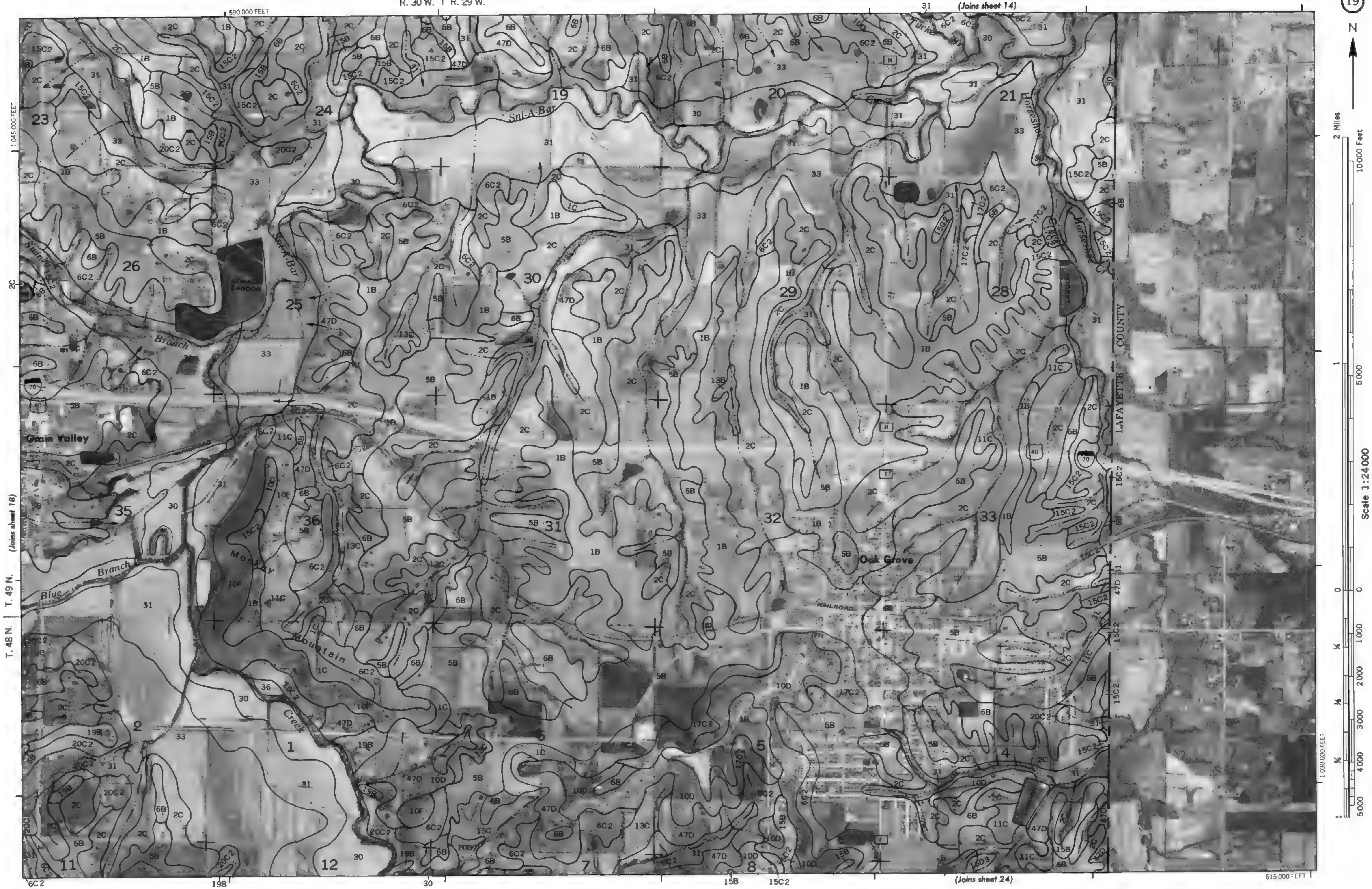


JACKSON COUNTY, MISSOURI — SHEET NUMBER 19



JACKSON COUNTY, MISSOURI NO. 19

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(2)

N

2 Miles

10 000 Feet

1

5000

Scale 1:24000

0

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JACKSON COUNTY, MISSOURI NO. 2

(20)

JACKSON COUNTY, MISSOURI — SHEET NUMBER 20

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JACKSON COUNTY, MISSOURI NO. 20

JACKSON COUNTY, MISSOURI NO. 21

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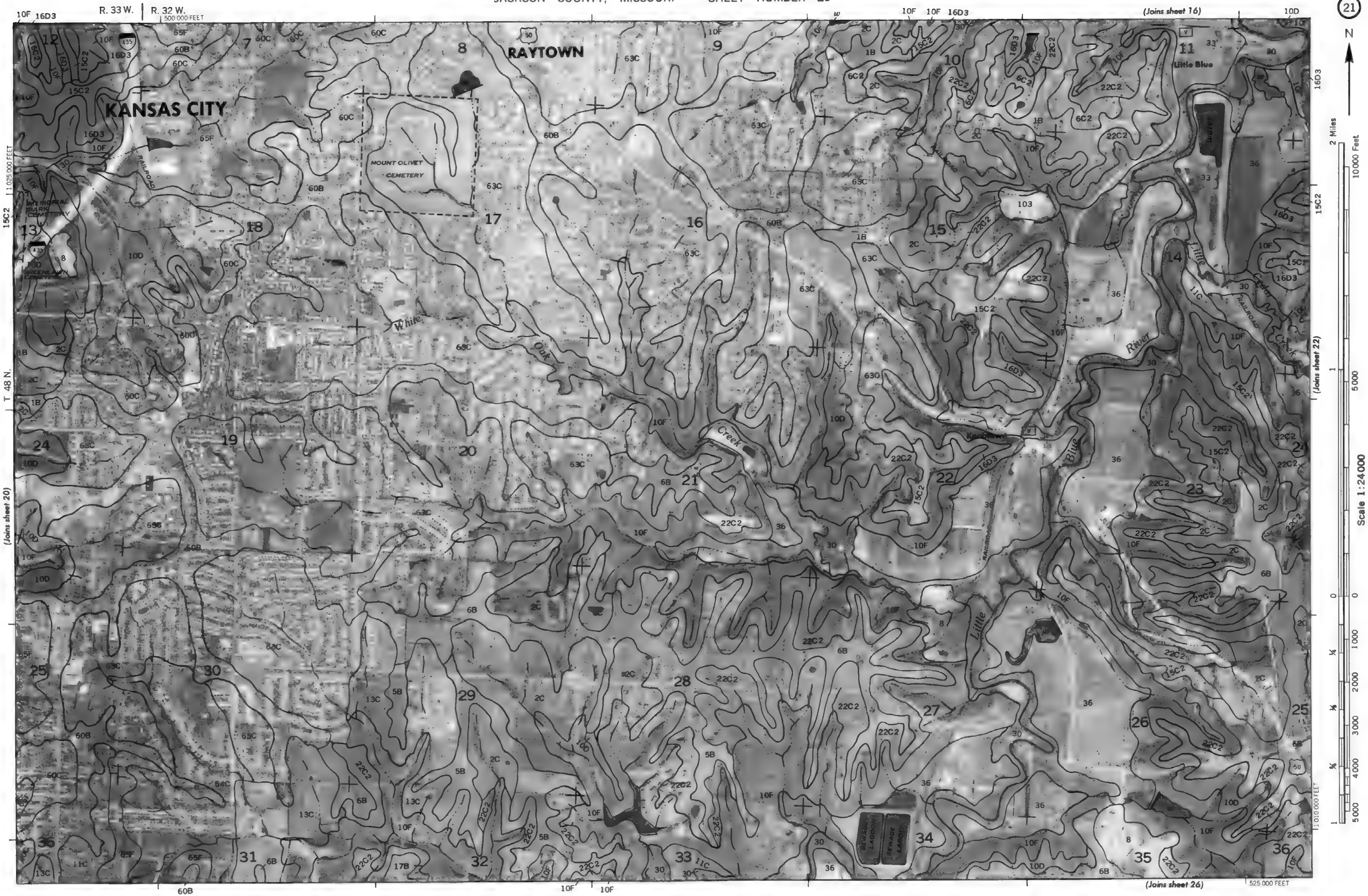


JACKSON COUNTY, MISSOURI — SHEET NUMBER 22

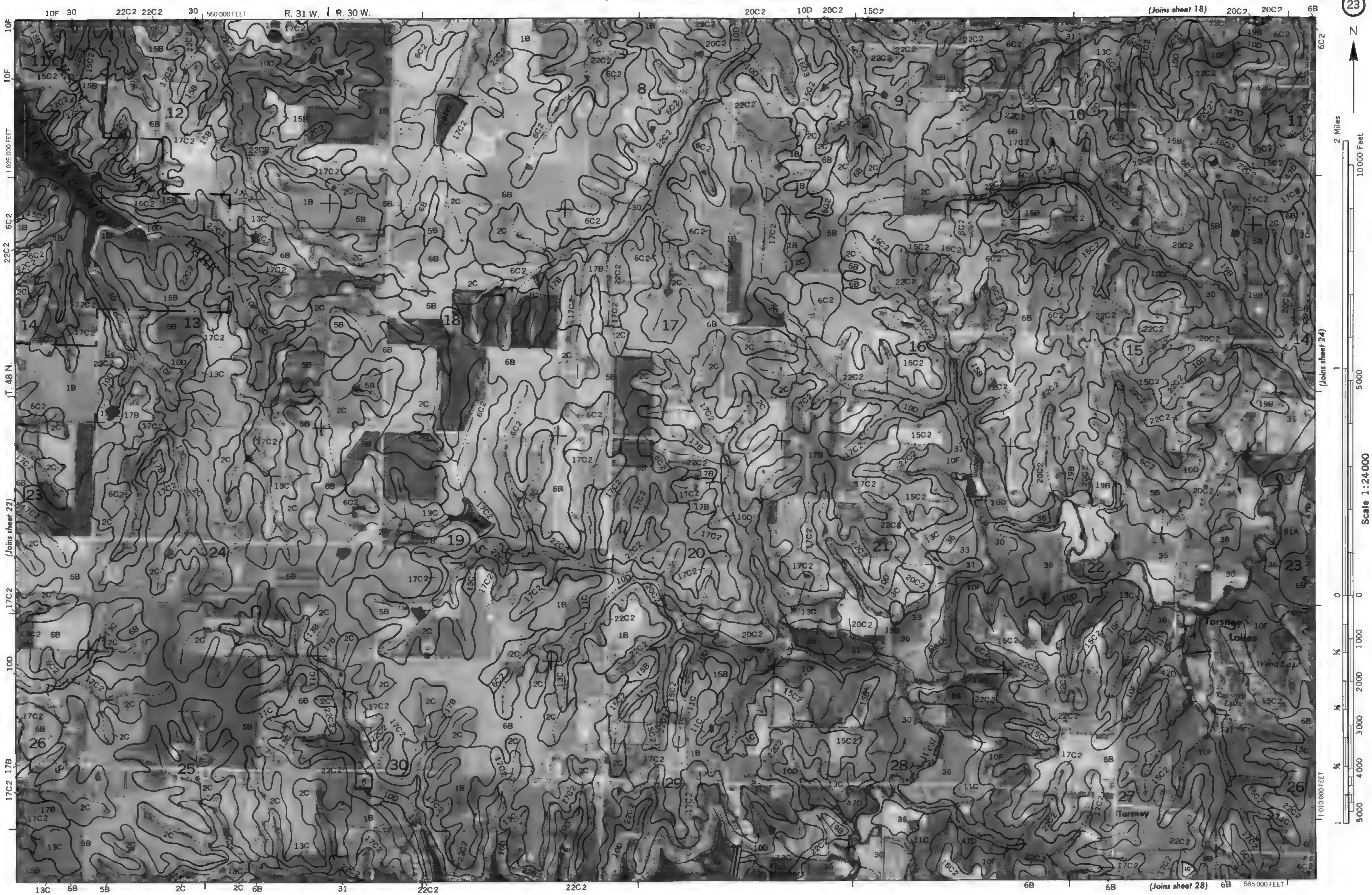
N

Scale 1:24000

2 Miles · 1 · 0 · ¼ · ½ · ¾ · 1

10000 Feet · 5000 · 0 · 1000 · 2000 · 3000 · 4000 · 5000

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



JACKSON COUNTY, MISSOURI NO. 23

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI — SHEET NUMBER 24

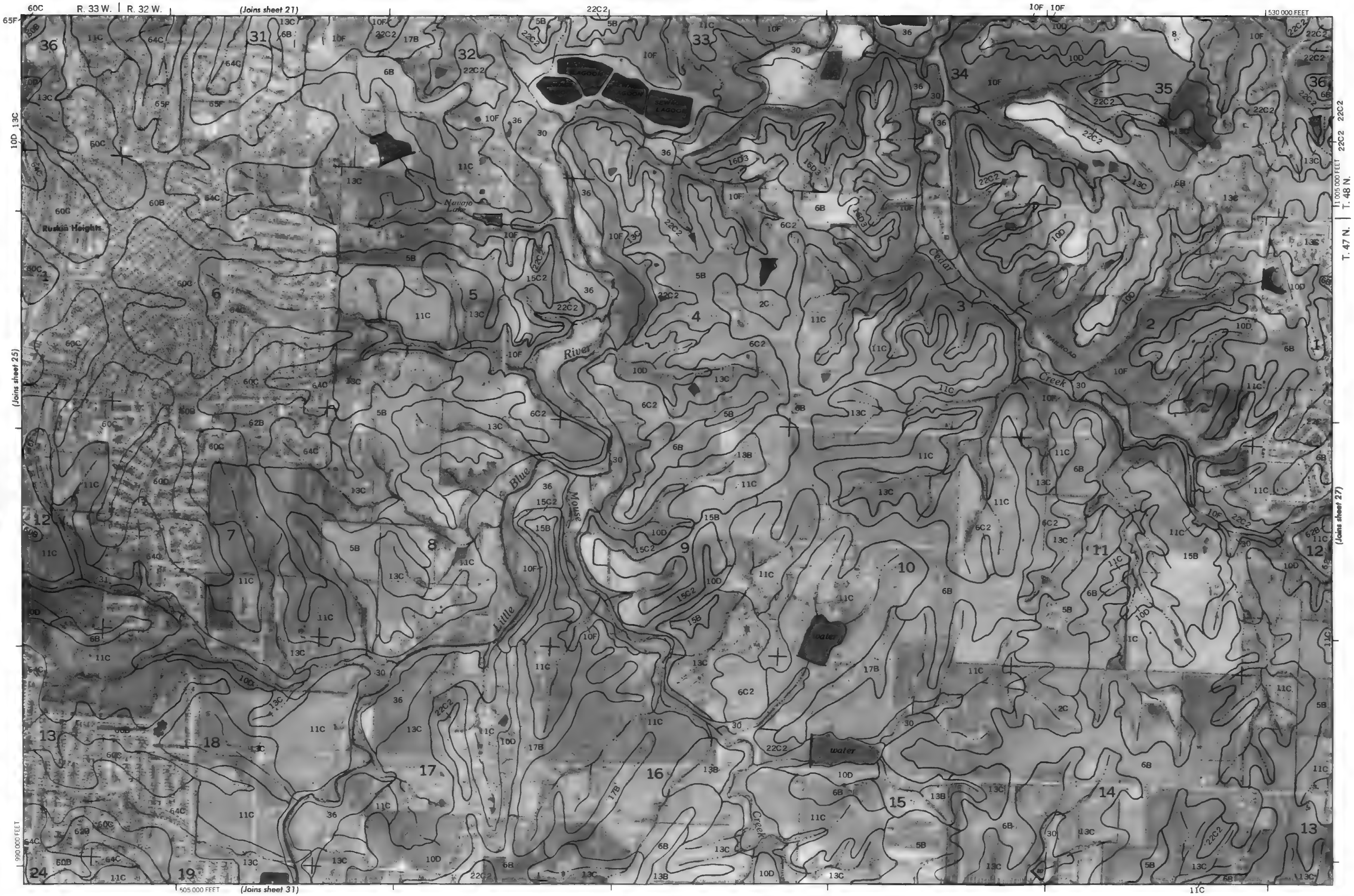
This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

JACKSON COUNTY, MISSOURI NO. 24

JACKSON COUNTY, MISSOURI NO. 25

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI — SHEET NUMBER 26



N

Scale 1:24000

2 Miles

10 000 Feet

This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI NO. 27

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI — SHEET NUMBER 28

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI — SHEET NUMBER 29

JACKSON COUNTY, MISSOURI NO. 29

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI — SHEET NUMBER 3

JACKSON COUNTY, MISSOURI NO. 3

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI — SHEET NUMBER 30

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI NO. 30

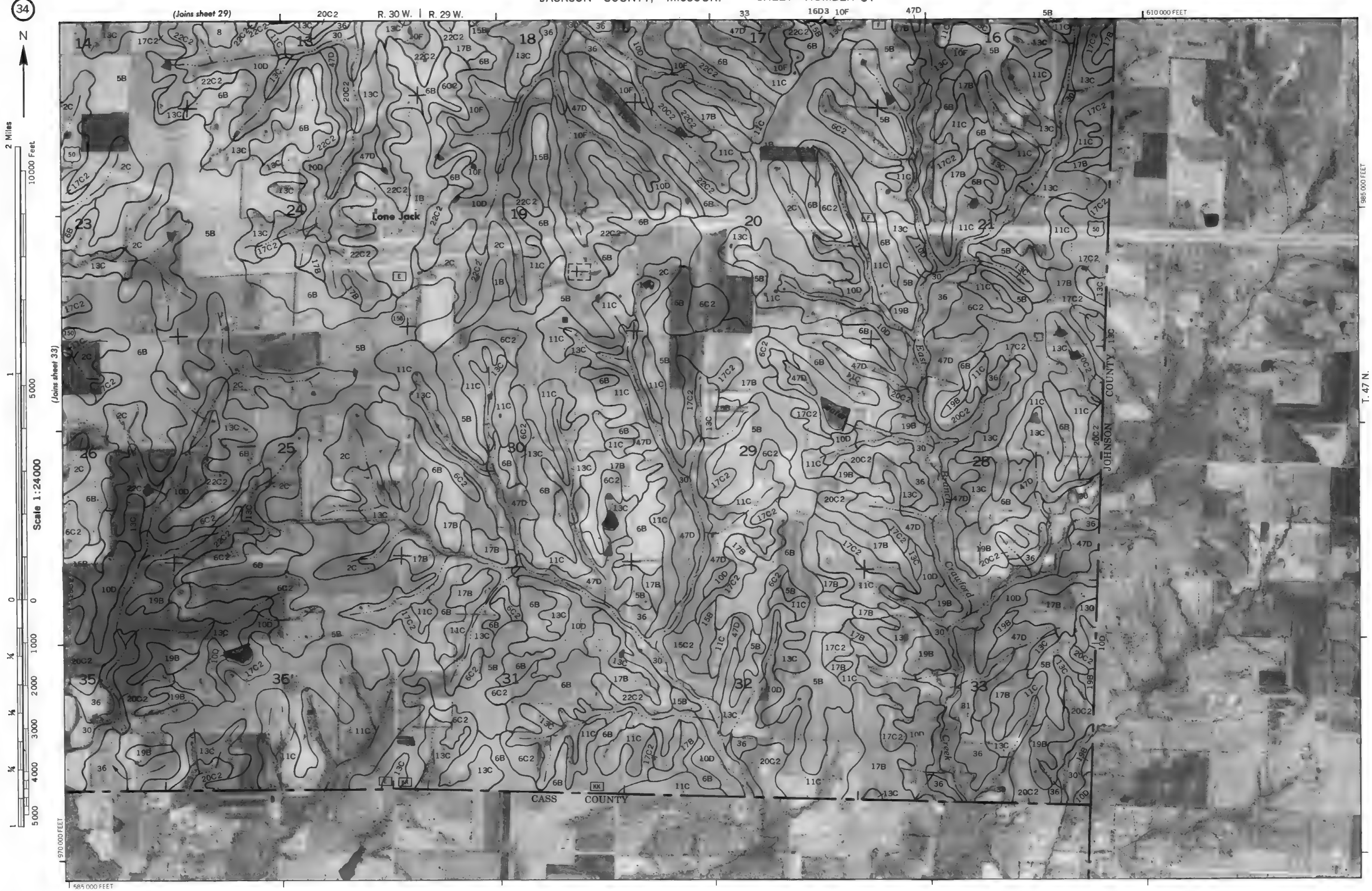
JACKSON COUNTY, MISSOURI NO. 31

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


32
N
R. 32 W
R. 31 W.
(Joins sheet 27)
(Joins sheet 31)
(Joins sheet 33)
Scale 1:24000
2 Miles
10000 Feet
5000
JAMES A. REED
MEMORIAL WILDLIFE AREA
Lake Nell
Gopher Lake
Greenwood
Big Creek
RAILROAD
CASS COUNTY
T. 47 N.
JACKSON COUNTY, MISSOURI NO. 32

JACKSON COUNTY, MISSOURI NO. 33

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI NO. 34

JACKSON COUNTY, MISSOURI — SHEET NUMBER 4

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI — SHEET NUMBER 5

5

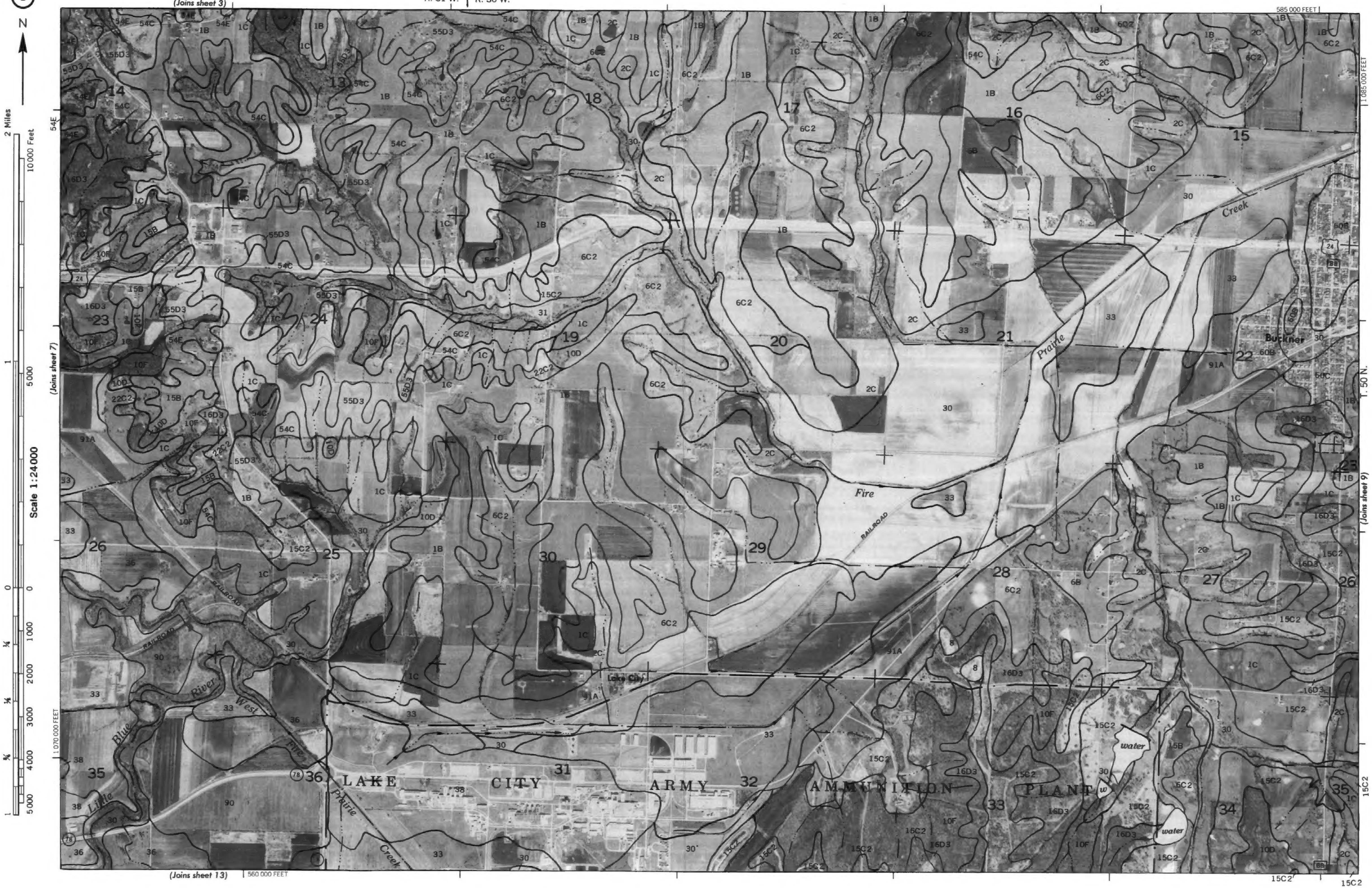
JACKSON COUNTY, MISSOURI NO. 5

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI NO. 7

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1975 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

JACKSON COUNTY, MISSOURI NO. 8

JACKSON COUNTY, MISSOURI NO. 9

This map is compiled on 1976 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.